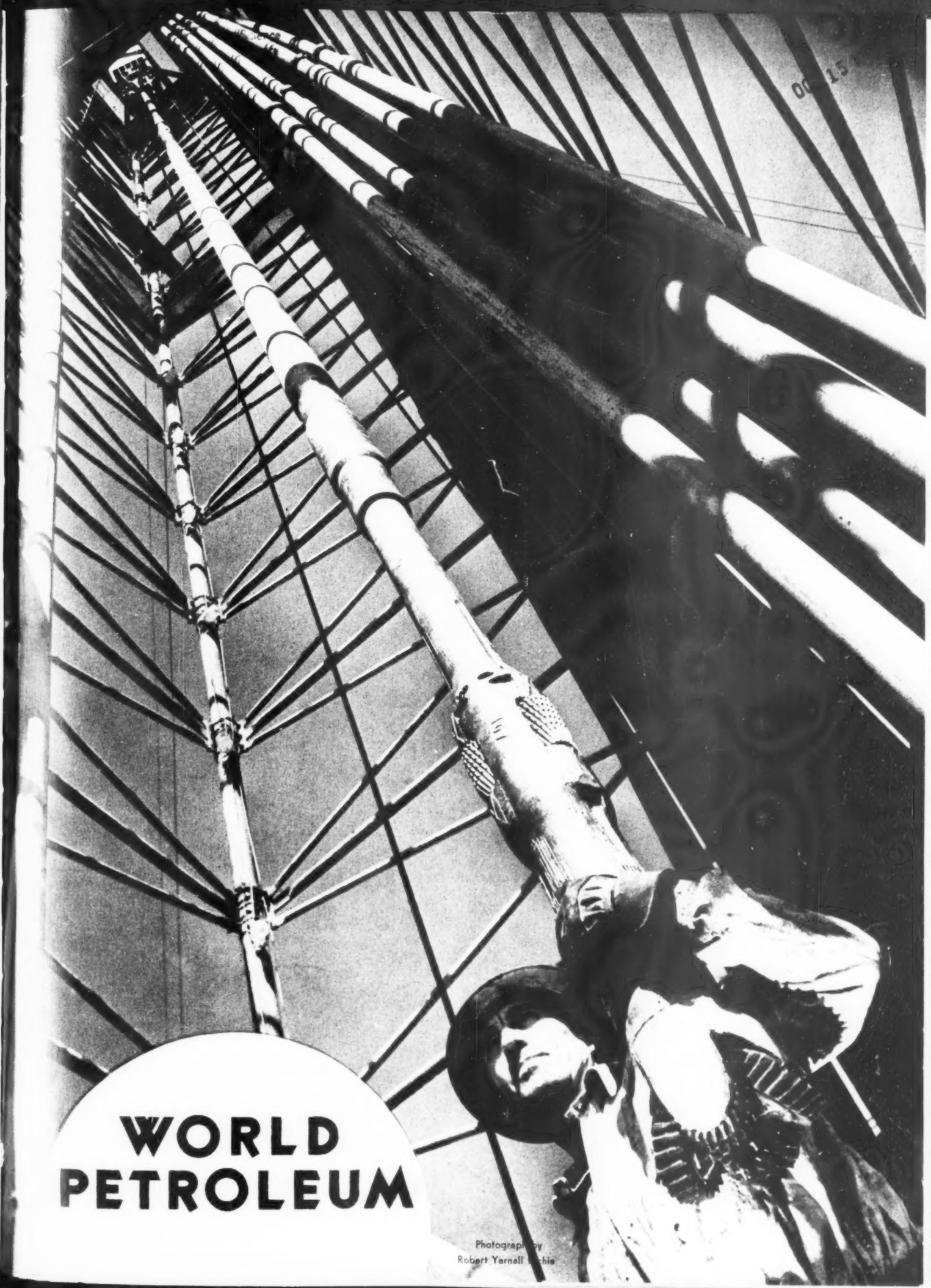


WORLD PETROLEUM

Photograph by
Robert Yarnell Richie

Gasoline
IS THE GOAL OF EMPIRE!

To Day power of the nations of the world is measured in H.P. . . . effectiveness of naval units are dependent on aerial supremacy and freedom will finally be won by mechanized victories. Natural Gasoline has contributed much toward the growth of the automobile, making possible the American-Way of Life — it will do more in preserving it. Hanlon-Buchanan is ready with a daily capacity of thousands of barrels of uniform Stabilized Natural Gasoline — STA-VOL-ENE the "Natural" known throughout the World.

Hanlon-Buchanan, Inc
PIONEER NATURAL GASOLINE MANUFACTURER

EXPORT TERMINALS:
Goodhope, La. Corpus Christi, Tex.
Houston, Texas Texas City, Texas
Baytown, Texas Galena Park, Texas

TULSA, OKLAHOMA
NATIONAL BANK OF TULSA BUILDING
PHONE 2-1181 or L.D. 398 WIRE — OR WRITE P. O. BOX 1559
Cable Address STAVOLENE, Tulsa, U. S. A.

FOREIGN REPRESENTATIVE:
Bates, Williams & Co., Ltd.
4 Lloyd's Ave.
London, England

WORLD PETROLEUM

Incorporating Petroleum Equipment Exporter

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

VOLUME 13 | OCTOBER, 1942 | NUMBER 11

CONTENTS

Oil Industry's Heavy Stake in Rubber . 21

Cut in 1943 Gasoline Consumption . . 22

Oil Resource Control 25

Model Peruvian Oil Towns 34

United Fuel Gas Compressor Station . . 38

Hull Designs 42

Camouflaging of Refineries 46

Preventive Maintenance 52

Abstracts 53

Rex W. Wadman
General Manager

E. W. Mayo
Editor

E. W. Mayo, Jr.
Managing Editor

Victor N. Raiser
Advertising Manager

Jack Selden
Art Director

COPYRIGHT

COPYRIGHT, 1942, by the estate of Russell Palmer. Contents may not be reproduced without permission.

CORRESPONDENCE

ADDRESS all correspondence regarding editorial, advertising and subscription matters to 2 West 45th Street, New York. Telephone: Murray Hill 2-7333.

Published monthly by the estate of Russell Palmer, 34 Crystal Street, East Stroudsburg, Pa.

London office: Brettenham House, Lancaster Place, W.C.2.

Pacific Coast Advertising Manager: Don F. Harner, 1595 Pacific Avenue, Long Beach, California. (Tel.: 613-238)

Mid-Continent Advertising Manager: O. F. Cozier, 2216 East 19th Street, Tulsa, Oklahoma. (Tel.: 6-9623)

Mid-West Advertising Manager: Willard R. Cotton, 307 North Michigan Avenue, Chicago, Illinois. (Tel.: Franklin 2508).

SUBSCRIPTIONS

Annual subscription is offered at the flat rate of $5.00 (U.S.) postpaid Single copies are obtainable at 50 cents

X.3358

Trainla
East C

EDITORIAL

OIL INDUSTRY'S HEAVY STAKE IN RUBBER

AS A result of the decision to regulate tire use throughout the country the fortunes of the oil industry for the immediate future and perhaps for the duration of the war are closely bound up with the rubber situation. Application of the program laid down by the Baruch Committee, involving a sharp reduction in average yearly travel of passenger automobiles, obviously requires a sweeping revision in refinery procedure to reduce the output of gasoline while increasing the production of lower priced products, particularly distillate and residual fuel oils. Whether overproduction of gasoline can be avoided, or if not, how waste of this valuable product is to be prevented, are practical and highly important questions. How extensive operating changes must be and how greatly they will disturb the established economic balance is the subject of a careful study conducted by the Economics Committee of the Petroleum Industry War Council. It needs no expert examination however to reveal that changes in the end products derived from a barrel of crude under the operating conditions proposed by the committee will increase tremendously the losses incurred in refining operations under the ceiling prices now in effect and that some adequate system of cost recovery must be adopted in order to maintain the financial equilibrium of the industry.

Some exaggerated notions of the effect of the rationing proposal upon gasoline consumption have gained currency such as the statement that it will involve a reduction of 45 to 50 percent in motor fuel use. Actually the Baruch Committee's stipulation is reduction from an estimated present 6,700 miles to 5,000 miles of travel as an average for privately owned motor cars. This is approximately 25 percent. Along with the decreased use of these vehicles, however, will go the increased usage of trucks and buses, the expanding needs of the rapidly growing armed forces and greater demands from others of the United Nations for military purposes. The actual reduction in demand for gasoline may not exceed 20 percent while the effect upon the total utilization of each barrel of crude will be much less, taking into account the rising consumption of other refined products.

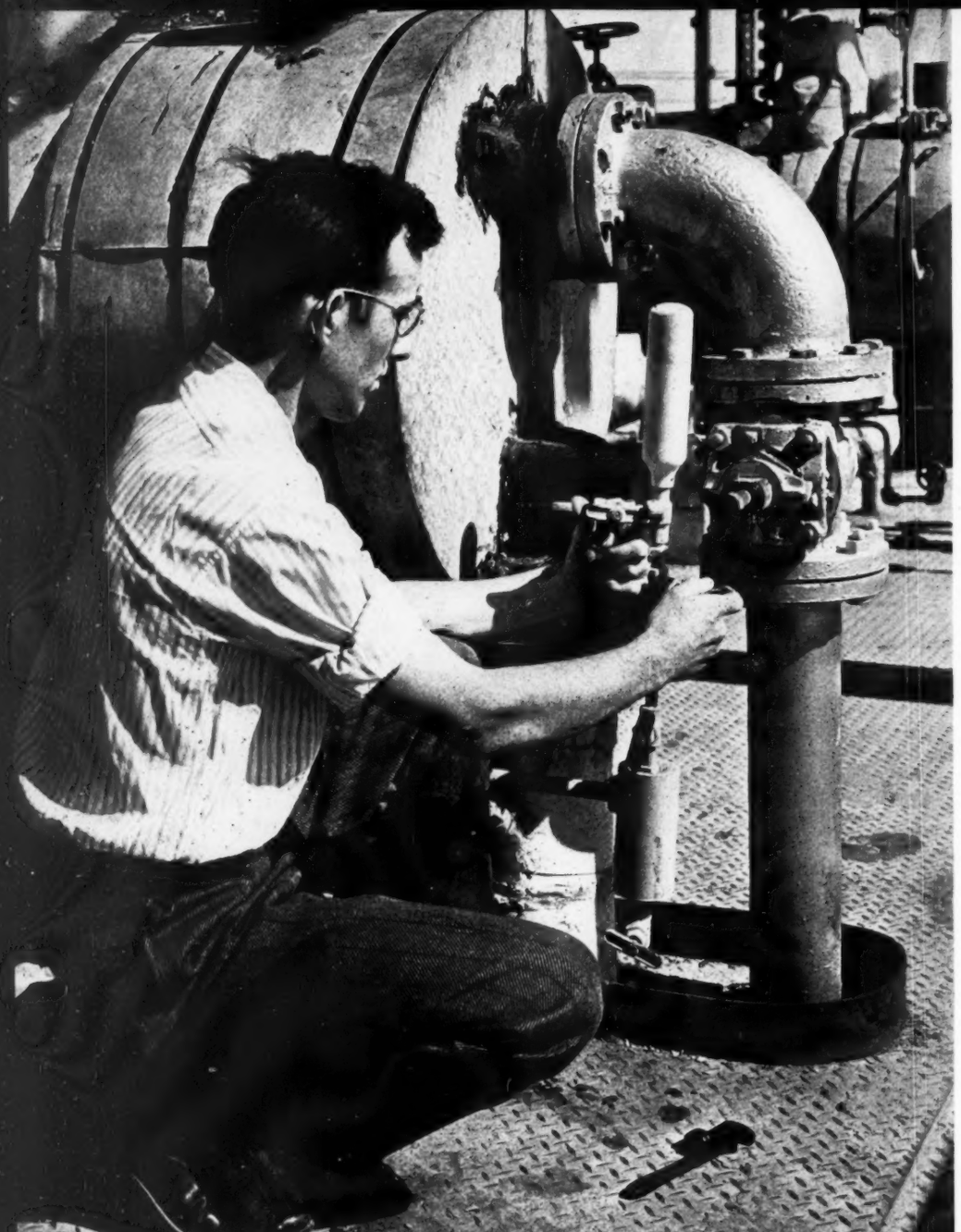
In its report the committee specifically states that its conclusions are based solely on consideration of the nation's rubber supply. "We are not restricting the use of gasoline as such," are its words, "we are rationing gasoline as the only effective measure to hold down tire use." Criticism of its findings on the ground that gasoline is in plentiful supply in most parts of the country therefore carries small weight in Washington. The fundamental theme of the report is that it is better to limit tire use immediately as nearly as possible to essential requirements than to permit the exhaustion of the precious rubber now on cars or in reserves that cannot be fully replenished before 1944 and thereby to risk a fatal breakdown in internal economy and in vital war production.

It is with a view to maintaining essential automobile operations that the committee urges the adoption of a replacement and tire recapping program and recommends an increase of thiokol production for use in this connection. The expressed regret that such a reconditioning program was not adopted early in the year indicates the committee's appreciation of the fact that the cause of conservation will be served by having tires retreaded before they are worn down to a state that makes them useless for reclaiming.

There is some force to the argument that less sweeping restrictions than those proposed would serve to tide the country over until synthetic rubber production can get into full operation, especially in view of the fact that the committee's estimates make no provision for withdrawals from reserves of natural rubber in 1943, except for military use. On this point the declared position of the committee is, "If we are to err it must be on the side of sterner curtailment and conservation to anticipate the worst danger that the war may bring." Hope for later easement is held out by the suggestion that if synthetic production reaches or exceeds expectations some relaxation of restrictions may safely take place.

As the Baruch Committee frankly admits the curtailment in tire usage which it proposes will impose hardships on individuals, communities and business. It certainly will impose serious hardships upon the oil business and those connected with it. The committee's remedy is to push forward the production of synthetic rubber with all possible speed. It approves the program now under way as technically sound, opposes changes in plans already laid but asks an enlarged capacity for buna rubber production and an additional output of 100,000 tons of butadiene through conversion of existing refineries. Since a great part of the task of providing the needed materials for synthetic rubber is entrusted to the petroleum industry the one way in which the industry can best serve the country and hasten its own return to a more nearly normal state of operation is by exerting every possible energy toward completing its share of this work with all possible speed.

Trainloads instead of carloads for East Coast. Photo by Ulric Meisel



Sampling butadiene from the production line at one of the rubber plants of the Standard Oil Company (N. J.). Synthetic rubber from butadiene promises relief for the rubber shortage by 1944 according to the Baruch report.

Gasoline Consumption May Be Cut Less Than 20 PER CENT FOR 1943

By E. W. Mayo, Jr.

Application of Baruch Committee Recommendations Apparently Would Reduce 1943 Motor Gasoline Consumption to 416 Million Barrels — Increased Aviation Demand Anticipated.

WHILE THE REPORT on the rubber situation recently transmitted to the President by the special committee composed of Bernard M. Baruch, Karl T. Compton and James B. Conant foreshadows profound modifications in the operation of the U. S. petroleum industry it has the peculiar virtue of settling in a definite manner many of the questions that have held the industry in a state of suspense through the first three quarters of 1942. From the reaction of the Chief Executive it may be assumed that the recommendations of the report will be implemented with all possible rapidity and in that sense it answers several of the questions that have agitated the oil industry all the way from office headquarters through the refineries of the Mid-West to the oilfields of the Gulf and the Pacific Coast. Such questions as how many cars will continue in operation despite the rubber shortage; when may relief in the form of synthetic rubber be expected; is nation-wide gasoline rationing necessary; and what form will the synthetic rubber industry finally take receive categorical answers in the findings and recommendations of the President's special rubber committee.

Of prime importance to the industry, the committee strongly recommends nation-wide gasoline rationing to limit the operation of necessary motor vehicles to an average of 5,000 miles per year. The report clearly states that such rationing is motivated entirely by the imperative need to conserve rubber and has nothing to do with the availability of gasoline supplies in any part of the country. Much of the report is devoted to the dangerous situation that will arise from short supplies of rubber if immediate steps are not taken to conserve existing tires and to rush to completion an expanded program for the manufacture of synthetic rubber. The fact that the committee examined every possible means of limiting tire wear before being forced to the conclusion that only gasoline rationing was practical for this purpose, and that it specifically states that gasoline rationing is intended solely to conserve rubber calls for special emphasis in view of official and unofficial protests from the Southwest. The governor of Louisiana, the governor of Texas and a recently formed association of independent producers in the East Texas field have protested against the proposed rationing on the ground that there is plenty of gasoline available in that area and that rationing will impose undue hardship on local motorists for no better reason than to relieve an East Coast shortage.

The industry as a whole, however, is concerned with the effect of nation-wide rationing on the demand for motor fuel. Unfortunately the committee limited itself to recommending that speeds be held below 35 miles per hour and that annual average car mileage be held to 5,000 miles. Drawing up of actual plans for nation-wide rationing is left to the Office of Defense Transportation with final implementation of these plans to be in the hands of Leon Henderson's OPA. All plans will be subject to the authority of Wil-

liam M. Jeffers, until recently president of the Union Pacific Railroad, and now czar of the rubber situation throughout the United States. Some time must elapse before the final plans for nation-wide gasoline rationing are completed and even more before the machinery is set up for its enforcement. In the meantime it is of interest to examine the possible effect on the demand for gasoline of a rationing plan which it is hoped will differ in many respects from that now in force on the East Coast. Nation-wide rationing may go into effect by November 22nd.

Plans for the manufacture of synthetic rubber are to be stabilized, some additional capacity is to be provided and the whole program is to be rushed to completion at the earliest possible moment. A survey of rubber supplies and demand considered in the light of plans for synthetic manufacture indicated to the committee that the year 1943, more particularly the third and fourth quarter of that year, would be critical. Existing tires will then have been used to their maximum, new supplies will have reached their lowest ebb and the synthetic rubber industry will only be approaching capacity output. During the first half of 1944, if present plans are carried through without undue delay the situation will be greatly relieved by synthetic rubber output from plants now building; by the end of 1944 the critical situation may be fully corrected and an adequate supply of tires may be available to civilians. In the interim the problem is mainly one of supplying military needs for the United States and the other United Nations and of maintaining essential mobility to avoid any interference with agricultural and industrial output vital to the war effort.

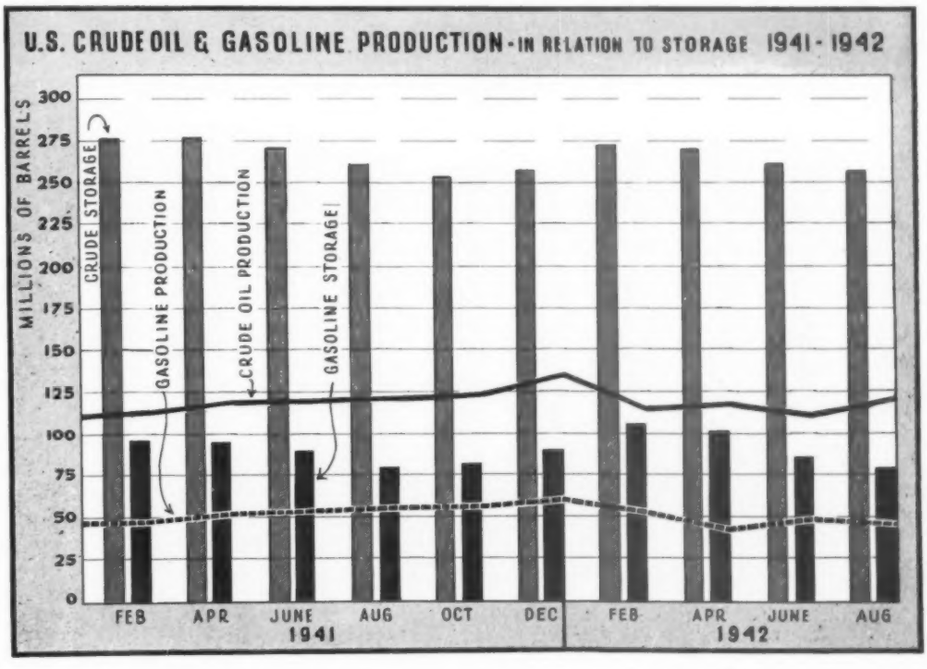
There are roundly 27 million passenger cars, 4,600,000 trucks and 150,000 buses in operation in the United States. During 1943 it is estimated that gasoline consumption by trucks will have increased to 164 million bbl. per year due to the additional requirements for transportation of war materials; bus consumption of gasoline may reach 22 million bbl. annually for the year 1943 in view of the reduced use of private passenger automobiles and the increased demands for transportation of workers in war industries. These 186 million bbl. of gasoline will have to be supplied in 1943 without reference to any reductions that may be effected in the use of passenger cars. Somewhere the rubber must be found to keep trucks and buses rolling.

In normal times the 27 million passenger cars average 9,000 miles per year each and get about 14 miles to the gallon. Recently the country-wide average has been reduced to 6,700 miles per year. However, for the last normal year of driving, 1941, the 9,000 mile yearly average is approximately correct. If this is reduced to 5,000 miles per year in line with the committee's recommendation average consumption for each automobile will be 357 gallons of gasoline per year or a total for all cars of 230 million barrels for the year 1943. To this must be added the 186 million barrels estimated consumption for essential trucks and buses giving total consumption for automotive uses in 1943 of 416 million barrels of motor fuel for the first full year of rationing against 622 million barrels of motor fuel consumed in 1941, the last full year before rationing. This represents a reduction in gasoline consumption of 206 million barrels or 33 percent.

A careful analysis of civilian requirements indicates the 416 million barrels is close to the minimum necessary to maintain essential mobility and to avoid interference with agricultural and industrial production contributing to the war effort. Of the 27 million passenger cars in the United States it has been estimated that 2 million might be eliminated entirely; these represent the extra cars in multiple car ownership families and the passenger cars belonging to farm families who also operate a light truck. Another 5 million passenger cars can be classed as unessential but might be given a minimum gasoline allowance in the absence of government machinery for the acquisition and the distribution of their tires to essential use. These 5 million cars would be reduced from the annual average of 9,000 miles to 2,000 miles and would require only 17 million barrels of motor fuel in 1943. With the elimination of 2 million cars and very drastic restrictions on the use of 5 million cars, there would be left the 20 million passenger automobiles classed as essential. But substantial savings in the mileage driven by these cars are possible.

Of the 20 million remaining cars 12 million are now in use in rural areas or small villages having no other means of transportation. By doubling up, reducing the number of trips from farm to market and eliminating all recreational and social driving a 30 percent reduction in mileage would be possible in the case of 12 million automobiles operating in rural areas. This would reduce gasoline requirements for this division to 129 million barrels for 1943. Automobiles operating in cities comprise, first, 1.5 million cars in small cities having populations between 25,000 and 50,000. Occasionally bus lines or street cars serve such communities and could absorb some part of the transportation load. Capacity is, however, sharply limited and privately owned automobiles supplement mass transport to an extent that permits a reduction of only 20 percent in mileage driven by these cars. Automobiles in such areas would require 18 million barrels of gasoline for the year 1943. Second, in medium size cities of 50,000 to 500,000 population where 3.5 million cars are in operation buses and street cars can absorb a somewhat larger share of the traffic now carried in private cars permitting a reduction in use of passenger automobiles of 25 percent. Cars in medium size cities would require during 1943 a total of 40 million barrels. Finally, in large cities having over 500,000 population subways, buses, street cars and suburban railroads can absorb a much heavier load. A 45 percent reduction in mileage driven by the 3 million cars in large cities would be possible; gasoline requirements for 1943 for this division would not exceed 25 million barrels.

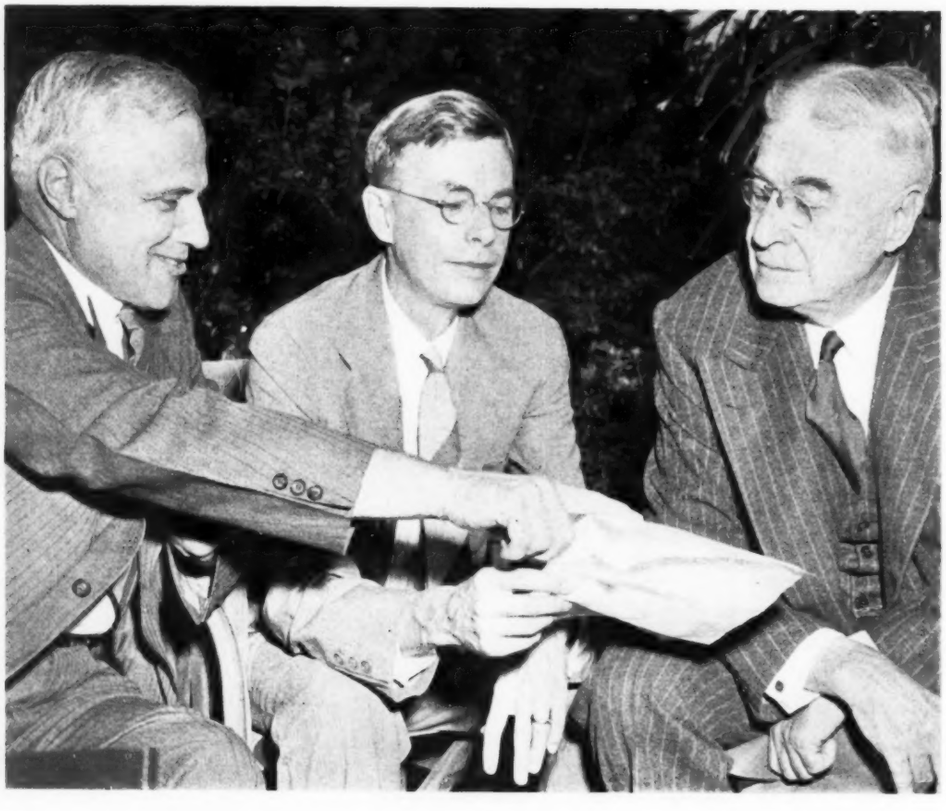
If the above calculations are correct, and they are based on data from AUTOMOBILE FACTS AND FIGURES, PETROLEUM FACTS AND FIGURES, and reports of the American Transit Association as analyzed by Charles L. Dearing for the Brookings Institute, we find: 5 million unessential cars would consume 17 million barrels; 12 million rural automobiles would consume 129 million barrels; 1.5 million cars in small cities would re-



quire 18 million barrels; 3.5 million cars in medium cities would require 40 million barrels and 3 million cars in large cities would require 25 million barrels or a total of 230 million barrels for U. S. passenger cars in 1943. To this figure must be added the consumption by trucks and buses which could not be reduced below the essential 186 million barrels making total consumption 415 million barrels for the critical year.

Minimum requirements analyzed from the point of view of maintaining essential civilian mobility at 415 million barrels in 1943 compares closely with the 416 million barrels that would be required by the recommendation in the special rubber committee's report if average mileage for 27 million passenger cars was reduced from the 9,000 mile normal to 5,000 miles in 1943. Viewed from either angle, a reduction of approximately one third would be registered in the use of motor fuel for automobiles, trucks and buses. The industry may, however, anticipate demand for aviation gasoline possibly in excess of 100 million barrels and non-automotive use of gasoline exceeding 70 million barrels during the year 1943. An indeterminate quantity of gasoline will be exported to the United Nations. Conservatively estimated, 70 to 80 million more barrels of gasoline will be required for aviation and non-automotive uses in 1943 than were consumed by these divisions in 1941 which will go far in taking up the slack in the industry's gasoline manufacturing capacity created by nationwide rationing to conserve rubber.

One of the first recommendations of the Baruch Committee to be put into effect was the appointment of one able man in charge of the entire rubber situation. Donald Nelson, (left) after consultation with the President, appointed William M. Jeffers (right) to this post in the WPB. Mr. Jeffers was formerly president of the Union Pacific Railroad and reported within a few days after his appointment that he was—"already at work" on the rubber situation. Photo by Harris & Ewing.



The special committee appointed by President Roosevelt to study the rubber situation consisting of Dr. Karl T. Compton, president of the Massachusetts Institute of Technology (left), Dr. James B. Conant, president of Harvard University (center) and Bernard Baruch, chairman of the Committee (right). Mr. Baruch was chairman of the War Industries Board during the first world war. The committee found the rubber situation extremely grave but susceptible to solution by 1943 if recommendations in their report were followed.

Iraqui oil workers inspecting equipment: Iraq oilfields have played an important part in international diplomacy for the past thirty years.

Control of Oil Resources in Relation to War

By Harry A. Stuart and R. G. Tracie

Rear Admiral, U. S. N. Senior Petroleum Engineer

THE POSSESSION or control of the world's oil resources appears to have had a profound influence on the incidence as well as the grand strategy of the two great wars of the Twentieth Century as well as on some of the relatively minor conflicts that occurred during this period. In the accompanying article the authors trace the position as regards ownership of oil prior to the first World War, the extent to which this position was altered by that conflict and the developments in control of the world's oil in the two decades between the first and second world wars. An examination of the evidence reveals that control of this all-important resource, which ranks high among the objectives of the warring nations may well prove a decisive factor in deciding the outcome of the present struggle.

The authors are well qualified to discuss the relationship between oil and war:

Rear Admiral Harry A. Stuart, U.S.N., was appointed to the Naval Academy from Virginia and graduated in the Class of 1904. In August 1918, while holding the rank of Commander, he was placed in charge of the fuel oil desk, Bureau of Steam Engineering, Navy Department, where he became interested in the Navy's fuel oil problems and in the naval petroleum reserves. Realizing the importance and value of the Navy's petroleum reserves, Secretary Josephus Daniels transferred Commander Stuart and his activities to the Office of the Secretary where together they established a sound policy covering the administration of the naval petroleum and naval oil shale reserves. Commander Stuart's special knowledge on these matters caused him to play a prominent part in exposing the oil scandals of the Harding administration and in the litigation which followed. Without doubt he risked his entire naval career by actively opposing the acts of his superiors, Secretary Denby and Rear Admiral John K. Robinson, Chief of the Bureau of Engineering, on the matter of the transfer of the naval petroleum and naval oil shale reserves from the

jurisdiction of the Navy to the Department of the Interior under Secretary Albert B. Fall. For four years during the Mammoth Oil Company litigation he was co-receiver of Naval Petroleum Reserve No. 3, Teapot Dome. Most of the past twenty-four years of his naval service has been spent on special duty in connection with the administration of the Navy's petroleum and oil shale reserves. Since June 1933, he has been attached to the Office of the Secretary of the Navy in the capacity of Director of Naval Petroleum and Oil Shale Reserves. Rear Admiral Stuart's valuable services to the Navy were rewarded when he was promoted to the rank of Rear Admiral by special dispensation of President Roosevelt in May 1939.

Ross G. Tracie, Senior Petroleum Engineer, Office of the Secretary of the Navy, received his technical education at the University of California where he graduated in 1920. Upon graduation he was employed by the Southern Pacific Railroad as an assistant engineer in connection with the valuation of the company's extensive oil lands for income tax purpose; on completion of this work he was employed as an assistant geologist and assigned to development work with the newly organized Pacific Oil Company. In this work he became familiar with the Navy's petroleum reserves since much of the company's operations were on lands within and adjacent to the naval petroleum reserves in California. He came to the Navy Department in 1929 and has served as technical advisor on petroleum technology and engineering matters in the Secretary's office since that time.

All statements made, opinions expressed and conclusions reached in this article are, of course, only those of the authors and they may or may not be concurred in by other naval personnel or by officials of the Navy Department.———EDITOR.

IT WOULD APPEAR to be no coincidence that the economic sickness which plunged first Europe and later most of the civilized world into World War number one reached its crisis just at the time the petroleum industry was beginning to hit its stride. The maldistribution of petroleum resources among European nations faced with the problem of keeping pace with the United States in industrial advancement might well have been one of the straws which finally precipitated the conflict.

Prior to the end of the first decade of the present century it seems to have been the presence of or control over natural resources of coal and iron which determined whether or not a nation could develop industrially. Labor and industry had, as a result, become stabilized largely on this basis. Both in Great Britain and in continental Europe were ample coal and iron deposits so that economically this part of the world tended to be affected only locally as industries were developed and machines tended to displace the greater labor required to produce goods by hand.

British industry and capital, apparently were among the first to realize that the fast growing oil business in the United States might forecast the development of a fuel source which would, because of its liquid form, higher heat content per pound, and other obvious advantages, seriously challenge the place of coal as a source of energy. As early as 1882, Captain Fisher, later to become Lord Fisher, Admiral of the British fleet, is said to have stated that replacing coal with oil as fuel for ships would increase the effectiveness of the British Navy's fighting force by fifty percent. Later developments have proved that the Admiral was one hundred percent correct. His record indicates that throughout his career, Admiral Fisher strongly urged that this drastic change be made in the British Navy. While there were no indications of oil in the British Isles, it was known that oil existed in considerable quantities in outlying British possessions, principally Burma, India, where the Burmah Oil Company, Ltd., a British Company, had been operating since the 1880's; on the island of Trinidad, where an immense lake of asphalt had been shown to early explorers by the Indians; and in Canada where oil in small quantities had been produced since the 1860's.

Probably the first real consideration given to the possible use of oil as fuel for marine boilers on vessels of the United States Navy should be credited to Rear Admiral George W. Melville from the time he became Engineer-in-Chief, in 1887. When oil was discovered at Spindletop, Texas, in 1901, the Navy Department became fully aroused and Rear Admiral Melville, then Chief of the Bureau of Steam Engineering, sought and obtained a special appropriation from Congress to be used to investigate the oil fuel problem and to conduct a series of tests to determine whether or not this type of fuel would lend itself to commercial marine and naval use. To this end the Naval Liquid Fuel Board was established to study the question. After making exhaustive tests, using the torpedo boat Rodgers

The late Sir Henri Deterding, mentioned in the accompanying article as one of the world's most astute oil executives: under his guidance the Royal Dutch Shell Group became one of the leading international oil forces.

Baku oilfields, pictured by Margaret Bourke-White in 1937. Baku was a major German objective in the first World War and is now repeating its former role but its importance has been greatly enhanced.

and other naval vessels, the Board filed an extensive report of its work on August 1, 1903. By 1908, the superiority of vessels designed to burn fuel oil exclusively had been clearly demonstrated in Great Britain and in the United States and the conversion of their navies to the use of oil was being seriously considered by both governments. British diplomacy had already begun to lay the ground work which would secure for Britain's Royal Navy and for her commercial interests the necessary oil resources in colonial possessions and in foreign countries and thus assure continued British naval and commercial supremacy on the high seas. Backed aggressively by British diplomacy, British capital began to search for and to secure oil concessions in foreign lands and in a few years British oil interests had become supreme in India, Persia (Iran), Peru, Ecuador, Egypt and Trinidad and had also gained control of important holdings in Rumania, Russia, the Dutch East Indies, Mexico and the United States. The inside stories of the international business deal and diplomacy connected with the acquisition of oil concessions in foreign lands by British and British-Dutch oil interests in competition with Standard Oil and other American interests and with French and German capital makes as exciting reading as the most interesting tales that have ever been written involving international intrigue.

While all of us are, in a general way, familiar with the development of the oil industry in the United States from the time of its beginning with the completion of the 69½-foot Drake well at Titusville, Pa., in August 1859, through the rise of the original Standard Oil Company and its disintegration at the hands of the Federal Courts in 1911, to the completion of the Continental Oil Company's 15,004-foot well at Wasco, California, in April 1938 (still the World's deepest well); and from the modest production in the United States of 2,114,000 bbl. (less than 5,800 bbl. a day) in 1861 to the production of 1,398,000,000 barrels (more than 3,830,000 barrels a day) in 1941; most of us are not so well informed on the development of the oil industry elsewhere in the world and of the struggles of the various factions seeking control of the production and distribution of the earth's black blood —petroleum—during that interval.

The history of the oil industry outside the United States is to a large degree the history of the growth of a few large companies financed principally by British, Dutch, French and American capital, and of the great industrial figures who directed their destinies. In 1913, the last complete year before World War number one, world petroleum production amounted to some 385,345,000 bbl. of which North America produced 274,370,000 bbl., 71.2 percent; South America 2,706,000 bbl. 0.7 percent; Europe 85,111,000 bbl., 22.1 percent; the Near East 1,955,000 bbl., 0.5 percent; and the Far East 21,183,000 bbl., 5.5 percent of the world's oil.

The position of the principal oil producing countries of the world just prior to the outbreak of the first World War will be reviewed briefly. While small quantities of oil had been produced in Canada since 1862 it was not until 1929 that production reached a million barrels per year. In 1913 Canadian oil production, principally from the Turner Valley field, amounted to 228,000 bbl. or 0.6 percent of the world's petroleum production. By 1941 it was 10 million barrels or 0.4 percent. In Mexico oil was first discovered by Lord Cowdray while engineering the Tehuantepec railroad; he obtained small production from a shallow well. By 1901 E. L. Doheny and C. A. Canfield had obtained small production in Tampico and were heavily involved in the Mexican industry. Lord Cowdray's holdings in the south had been transferred to Mexican Oil Company, Limited (El Aguila) which proceeded to bring in the famous Dos Bocas gusher in 1908. In the years immediately following the Mexican Eagle and Doheny's Mexican Petroleum Company developed some of the most valuable oil lands in the world; Mexican production increased from one million barrels in 1907 to 26 million in 1913 amounting to 6.6 percent of the world production. By 1921 Mexican production had reached a peak of 193 million barrels, 39.6 percent of world production; from this point it declined until in 1941 it was slightly less than 40 million barrels, less than two percent of world production. Meanwhile the Royal Dutch Shell had entered the field and the powerful competition between the British and American interests led to the unconfirmed suspicion that opposition by Doheny and other American companies to the growing strength of the British position under the regime of President Diaz played a part in his overthrow and the years of civil strife that followed. With the rise of Carranza (who was neither pro-British nor pro-American but decidedly pro-German) and the adoption by his administration of a Mexican constitution declaring that: "In the nation is vested direct ownership of all minerals, petroleum, and all hydrocarbons —solid, liquid or gaseous. . . . " the way was paved for the Mexican government to expropriate the properties of the foreign owned oil companies who had discovered and developed the oil resources. Had the first World War not inter-

Many of the primary objectives of modern warfare consist of oilfields and refineries; the importance of oil to modern warfare outweighs even its importance to peacetime economic development. Photo by Charles Phelps Cushing.

vened and had the Royal Dutch Shell been able to enter the Mexican fields by acquiring the Cowdray and Doheny properties as it was negotiating to do, it seems highly probable that Mexico might have been drawn quietly within the sphere of British economic influence so far as concerned what was at that time the country's most important and powerful industry.

In South America Lobitos Oilfields, Ltd., organized in 1908, took over operation of existing Peruvian fields and acquired further concessions from the government. Oil production increased from 274,000 bbl. in 1900 to two million barrels in 1913, representing 0.5 percent of the world production; in 1941 production was 12.8 million barrels or 0.6 percent. Production in Trinidad began in 1900 and is almost entirely in the hands of British companies. In 1913 Trinidad production was half a million barrels or 0.13 percent of the world's production; by 1941 it was 21 million barrels or roughly one percent. Oil was discovered in Argentina in 1907 and by 1913 amounted to 131,000 bbl. or 0.3 percent of the world's production; in 1931 this production had increased to 21.7 million barrels or one percent. Production is controlled largely by the government through Yacimientos Petroleferas Fiscales.

Russian oil production had reached 63 million barrels per year by 1913, or 16.3 percent of world production. At that time the firm of Nobel Brothers, founded in 1876 controlled the largest single share of the Russian industry amounting to about 14 percent. The other principal foreign capital was furnished by Royal Dutch Shell which acquired various British and French interests in Russia in 1912. By 1941 the Soviet Union ranked second in world production with 242 million barrels or 11 percent of the world's output. Rumanian oilfields were developed by British, French and German capital which through the Steaua Romana Petroleum Company controlled more than 20 percent of the Rumanian industry in 1913 at which time production amounted to 13.5 million barrels or 3.5 percent of the world's production; in 1941 Rumanian production reached 40 million barrels amounting to two percent of the world. Poland, one of the oldest areas in Europe, produced eight million barrels or two percent of the world production in 1913; by 1941 production had dropped to 3.4 million barrels or less than 0.2 percent of the world's production. German capital controlled most of the production prior to 1913. Oil in the Hanover district of Germany was probably first exploited about 1890. German production, including that of the Pechelbronn district in Alsace, first exceeded 1,000,000 bbl. in 1908 and remained above that amount until 1913, when it declined to 857,000 bbl., or about 0.2 percent of the world's production; in 1940 oil production from these areas aggregated 5,000,000 bbl., a little more than 0.2 percent. While there is some oil in Czechoslovakia, Italy and Albania, no important fields have yet been developed. In 1913, Italy produced only about 47,000 bbl., an infinitesimal part of the world's production. The principal production in Albania is from the Devoli field located at the junction of the Devoli and Osum rivers near the town of Berat. Oil has been produced here since 1930. In 1941 Albanian oil production amounted to some 1,250,000 bbl. less than 0.06 percent of world production. Prior to the first World War only one field had been discovered in Egypt. In 1913 Egyptian production was only some 98,000 bbl., an extremely small part of world production. In 1918 a new field was discovered at Hurghada and in 1939 the Ras Gharib field was opened in the Gulf of Suez; these discoveries, both of which are controlled by Anglo-Egyptian, have increased considerably the importance of Egypt as an oil-producing country. In 1941, it is estimated that Egypt's production amounted to about 8,050,000 bbl., or some 0.3 percent of world production.

Iran (formerly Persia), is unquestionably, one of the world's most important oil producing countries and the history of its development is extremely interesting. In 1901 D'Arcy secured from the Shah of Persia a concession giving him the exclusive right to explore for and exploit oil, except in the five northern provinces of the country, for a period of sixty years. The consideration for this concession is reported to have been a bonus of 200,000 francs and a guarantee of sixteen percent of the profits from operations. In 1903 D'Arcy struck oil in the Maidan-i-Naphtun field along the flank of the Bakhtiari Mountains and formed the First Exploitation Company. It is reported that the capital for this undertaking was furnished by the British owned Concessions Syndicate, Ltd., and the Burmah Oil Company, Ltd., and by Lord Strathcona. In 1909 the Anglo-Persian Oil Company, Limited, was formed to acquire control of the company—and of the Bakhtiari Oil Co., Ltd., another D'Arcy company operating in Persia. It was through the Anglo-Persian Oil Company that the British Government actively entered the international oil business. Owing to the prolific potential production of the Anglo-Persian wells, the directors of Great Britain's oil policy early decided that the expense of building sufficient storage to supply the reserves of petroleum products required by civil demands and by the Royal Navy, and of buying oil in the open market, probably would be inadvisable. Consequently, when Winston Churchill urged the government to secure a reliable all British-controlled oil supply in the ground to assure its own oil requirements, his counsel was heeded. The Anglo-Persian Company was ideally situated for this purpose and by an agreement dated April 6, 1914, the British

Another of the world's great oil centers—Iran. Early in the present conflict the British took steps to protect this all important source of supply. Photo by British Combine.

Government, for the sum of £2,200,000 (about $10,500,000) purchased a controlling interest in the company and thereafter two members of its directorate were appointed by His Majesty's Government. The British Government's foresight in purchasing control of the Anglo-Persian has frequently been ranked in importance and value with its earlier purchase in 1875, of the controlling shares of the Suez Canal.

That the British Government has proved itself to be a first-class oil operator can be seen from the fact that during 1940, 75 wells of the Anglo-Persian (now called Anglo-Iranian) produced more than 78,592,000 bbl. of oil, or at an average daily rate of 2,810 bbl. per day, while the average well in the United States produced only nine barrels daily. Thus, in 1940, the Anglo-Iranian alone produced more than fifty percent more oil than the 50,000,000 bbl. of petroleum products estimated as having been consumed in the British Isles by civil activities during the year.

The British Government has already been repaid many times over its investment in Persian oil and at the same time there has been clearly demonstrated the soundness of its established policy of providing ample supplies of petroleum in the ground where it can remain until needed by the Government for its own use in times of emergency, instead of depending on scant surpluses of petroleum products held in tankage on the surface. The United States Navy Department long ago recognized the value of such a position and to that end sought and secured the setting aside of Naval Petroleum Reserves in California in 1912. The Navy's petroleum reserves, however, do not enjoy a monopolistic control of production in the areas so set aside as do Britain's Persian fields and the Navy has, therefore, been faced with the problem of protecting its valuable oil lands from exploitation by private commercial interests in an irresponsible manner.

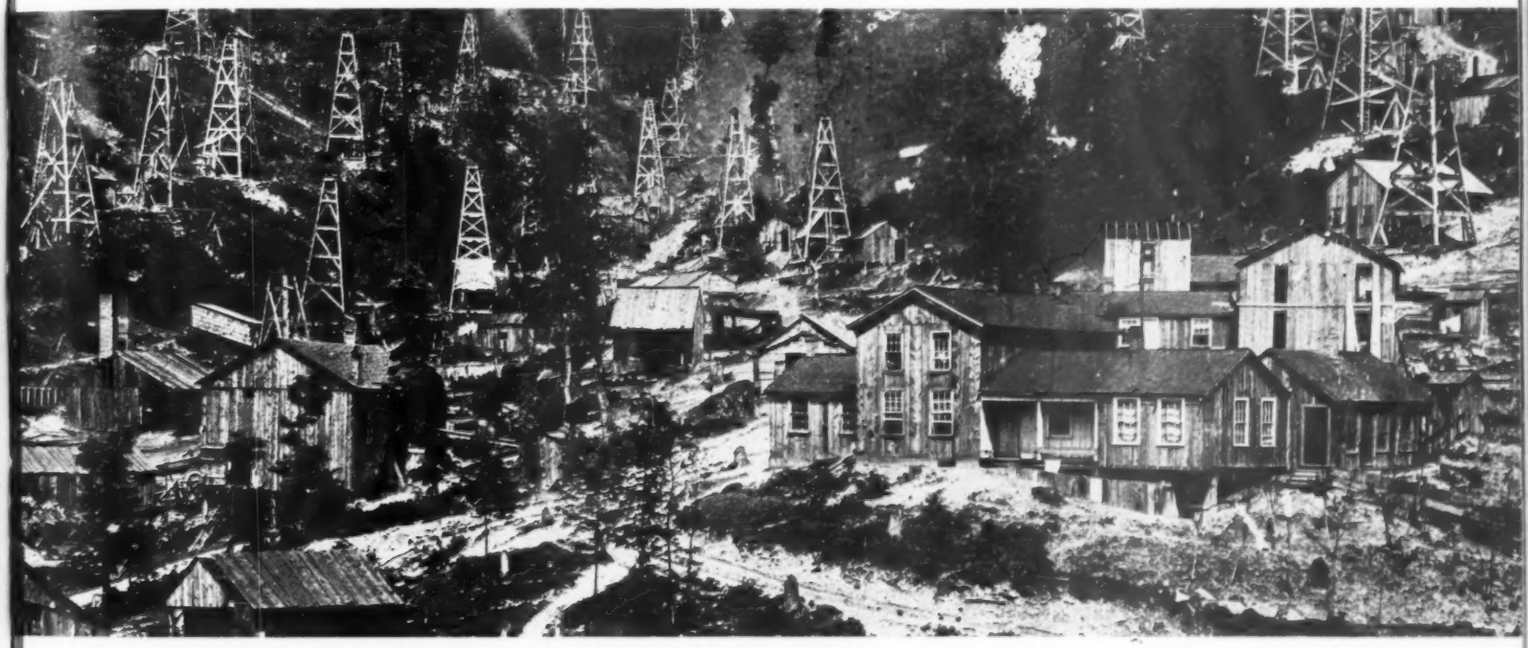
In 1913, Iran produced 1,857,000 bbl. of oil, or about 0.5 percent of the world's production; in 1941 production amounted to 64,150,000 bbl., a little less than three percent.

Although oil has been known and used in India since antiquity, it was not until the British-owned Burmah Oil Co., Limited, was formed in 1886, to operate concessions granted by the Burma Government, that the country's oil resources began to be developed actively. Since 1883, the ownership of minerals in India has been restricted to British nationals and in 1889 the Burmah Oil Company was given a blanket 99-year concession to develop the oil resources of Burma and to protect the company from all forms of foreign competition. Production in 1913 aggregated 7,930,000 bbl. and in 1941 was 7,900,000 bbl., practically unchanged in 28 years, a little less than 0.3 percent of world petroleum production.

Although oil has been produced since about 1875 in the Japanese islands of Hondo and Yesso, the fields have not been prolific and the wells produce only small quantities of oil. Production exceeded 1,000,000 bbl. for the first time in 1901, and in 1913 amounted to 1,940,000 bbl. Japanese oil operations on the island of Sakhalin, under an agreement with Russia, have increased the quantity of oil under Japanese control to about 3,800,000 bbl. in 1941, less than 0.2 percent of world production, a figure estimated to be at least 30 million barrels short of the country's civil, military and naval requirements. This deficit in oil is apparently one of the principal causes for Japan's seizure of the East Indies where production in 1941 amounted to some 61,000,000 bbl., or about double Japan's present annual requirements and about sufficient to supply the sphere of influence Japan seeks to establish in Asia and the islands of the Pacific Ocean.

In 1890 the Royal Dutch Oil Company (Koninklijke Nederlandsche Maatschappij) was incorporated in Holland to produce and market oil in the Dutch East Indies. At that time the principal oil production in the Islands came from Sumatra. By 1894 development of the company's concessions was well under way and in 1895 production passed the 1,000,000 bbl. mark. About this time the Royal Dutch Oil Company, backed by the banking houses of Rothschilds in Holland and France, secured control of the Caspian Black Sea Company and the Mazut Co. (Rothschild interests) operating in and marketing oil from the Russian oil fields. By 1894 the Royal Dutch began to invade the European markets, some 90 percent of which were then being supplied by the Standard Oil Co. by virtue of its control of transportation, refining and marketing of Pennsylvania production in the United States. At about this same time, another important factor entered the world oil picture in the form of the British-owned Shell Transport and Trading Co., Ltd., organized in 1897 to carry on trade in shells in the Dutch East Indies—hence its name. The Shell Transport and Trading Co. soon discovered the business of transporting and marketing illuminating oil from the Dutch East Indies to be more profitable than the shell trade market. This discovery led to its obtaining an interest in oil production in Borneo, where it came in contact with the Royal Dutch Co., which by this time had extended its operations to include the islands of Java and Borneo. Since the Shell Transport and Trading Company possessed

The start of the industry that was to affect the issues of world war and peace. Pennsylvania oilfields in 1864.



Baba Gurgur No. 1 discovery well in the Mosul section of Iraq. Discovered by the Turkish Petroleum Company before the first World War, these fields played an important part in the strategy of that War, in the peace negotiations and in orientation of the present war.

transportation and marketing facilities while the Royal Dutch virtually controlled production in the East Indies, the directors of both companies soon realized that rivalry between them could be ruinous. In 1902 these companies combined their interests and formed the Asiatic Petroleum Co., Ltd.—owned one-third by Royal Dutch, one-third by Shell and one-third by Rothschilds—for the purpose of marketing petroleum products in Europe and Asia. The new combine was now in a position to compete with Standard Oil for the immense illuminating oil markets which the latter had pioneered and developed in China and Manchuria. The price war between Standard Oil and Asiatic Petroleum for control of these markets lasted for several years and, while distinctly advantageous to the Chinese, played havoc with the earnings of both companies. By 1907 the wedding of the Royal Dutch and Shell companies was complete and the Royal Dutch Shell combine, with its numerous subsidiaries, was born. Reputably the new organization was owned 60 percent by Royal Dutch and 40 percent by Shell Transport and Trading Company stockholders, but since much of the stock in Royal Dutch was owned by French and British investors, the company may have been predominantly British-owned even at its conception. Management of the new company was placed in the hands of the general manager of the Royal Dutch group, H. W. A. Deterding, one of the ablest of the many prominent industrialists the oil industry has developed. In 1911 the Shell and the Standard decided to compromise their differences in Asia and came to a mutually satisfactory understanding by agreeing to divide the contested markets equally. This arrangement marked the beginning of an understanding which has led to the division of the world market for oil, outside of the United States, among the American, British and British-Dutch oil interests. What its effect has been on the world, in the light of the constantly increasing importance of petroleum in all civilized countries, can well be imagined. Oil production in the Netherlands East Indies amounted to 11,172,000 bbl. in 1913, about three percent of world production; in 1941 it was 61,000,000 bbl. but still was less than three percent of the world's present production.

In 1913 the Royal Dutch Shell combine entered the United States by acquiring control of the British-owned California Oilfields, Ltd., a company operating in the Coalinga and Kern River fields of California, and of the Roxana Petroleum Co., operating principally in Oklahoma.

The world's oil production in 1914 aggregated some 407,544,000 bbl. of which 265,763,000 bbl. (65 percent) were produced in the United States and 141,781,000 bbl. (35 percent) represented foreign production. Of the foreign production about 40 percent was produced by affiliates of the Royal Dutch Shell combine and a similar quantity by divers British operators—principally the Anglo-Persian in Persia; the Mexican Eagle (Lord Cowdray interests) in Mexico; Lobitos Oilfields, Ltd., in Peru; Brumah Oil Co., Ltd., in India and by a number of small companies operating in the Island of Trinidad. The only known American-owned foreign production at that time was that of Doheny's Mexican Petroleum and Huasteca Petroleum Companies operating in Mexico, which produced some 8,231,000 bbl., or about 5.8 percent of foreign production. At that time the British and British-Dutch interests had complete monopolies of oil production in the East Indies, Burma, Persia, Egypt, Trinidad and Peru, with substantial minor interests in the production of Russia (16.4 percent), Rumania (50 percent), and the United States (2.5 percent). In fact, the boast of Sir Henry Deterding (directing head of the Royal Dutch Shell combine) that unless unforeseen events occurred, within ten years the Royal Dutch Shell would dominate the fuel oil supply of the world and that no oil burning ship would sail the seas without Royal Dutch Shell oil in its bunkers, seemed near to accomplishment. Also, Lord Fisher, Admiral of the Royal British Navy, is said to have stated: "Mr. Deterding, in his evidence before the Royal Commission, confesses that he possesses in Rumania, in Russia, in California, in the Dutch East Indies, in Trinidad and shortly in Mexico (Royal Dutch was then negotiating to acquire control over the Lord Cowdray and Doheny interests) the controlling interests in oil. The Anglo-Persian Company also say he is getting Mesopotamia and squeezing Persia, which are practically untouched areas of immense size reeking with oil. Without doubt, Mr. Deterding is Napoleonic in his audacity and Cromwellian in his thoroughness. Sir Thomas Browning in his evidence says that the Royal Dutch Shell combine is more powerful and aggressive than ever was the great Standard Oil trust of America."

There were certain fundamental differences in the oil policies of Standard Oil in the United States and the Deterding directed companies in foreign lands, in their efforts to dominate the industry within their respective spheres of influence. These were, essentially, that Standard early realized that it would not be practicable to attempt to control the production of petroleum in the United States even in the Pennsylvania region alone, because of the multiplicity of land ownerships involved and the company, therefore, directed its efforts toward securing control over crude oil transportation, refining and marketing facilities. That these efforts were not unrewarded is shown by the fact that prior to 1890 the Standard Oil Company distributed and sold about 90 percent of the world's refined petroleum products through a world-wide organization.

In Europe and in the colonial possessions of European powers, however, conditions differed from those in the United States and Sir Henry Deterding realized that all phases of the industry might be controlled since in most instances the governments differentiated between ownership of the surface of the land in their domains and ownership of the minerals contained in the subsoil which were legally the property of the state. It was possible, therefore, in Europe and in European colonial possessions, for strong interests to secure long term monopolistic concessions from the governments to vast tracts of land for oil exploration and exploitation, to the exclusion of all competitors. Sir Henry Deterding probably also realized that while he could never compete with American refining interests, the possession of diversified production offered certain advantages which larger scale American operations could not overcome—that by owning production in all parts of the world, he would necessarily be in a better position to supply petroleum products to the world's markets. By controlling production and transportation of petroleum, the Shell would be able to exercise a strong and perhaps controlling influence on the oil trade of most of the other parts of the world.

In contrast to the British position as personified by Royal Dutch Shell, Anglo-Persian and various other British-controlled companies, which as we have seen, controlled about 80 percent of the oil produced outside the United States in 1914, Germany controlled only the Hanover and Pechelbronn fields with an aggregate production of some 781,000 bbl., and had interests in Galician and Rumanian fields where the German-owned Steaua Romana Petroleum Company controlled about 20 percent of the production, or some 2,675,000 bbl. In all, Germany had assured oil supplies amounting to about 3,500,000 barrels a year—probably some 20 or 25 percent of its peacetime requirements and 0.8 percent of world production. Thus, before the first World War, we find German industry faced with the problem of competing with the looming mass production methods developing in the United States while at the same time paying tribute to the American oil industry for the petroleum necessary to lubricate the wheels of its factories and

transportation facilities. In foreign commerce, its coal burning vessels had to compete with faster, cleaner British and American shipping fueled with oil or pay similar tribute on fuel supplies to secure for its ships the same efficiency.

It must have been apparent in Germany long before the war that the British-American oil monopoly would some day have to be broken, no matter what the cost, or Germany's place among nations would steadily retrogress. Such a position, quite naturally, would conceivably gall a people having the racial characteristics and the ambition for world leadership of the Germans.

Probably the first definite information on the trend toward war was disclosed by the construction, 1909-11, of several large battleships of the dreadnaught and superdreadnaught classes, for the German Navy. Britain rightly interpreted this as a probable ultimate challenge to her control of the seas and countered the act by definitely taking steps to convert the British Navy to oil fuel. Since fuel oil contains some 19,000 heat units (B.T.U.s) per pound as compared to about 13,000 B.T.U.s per pound for coal, it is apparent that the use of oil would increase the range of action of naval vessels by almost 50 percent; its fluid state, too, permits the use of space for fuel stowage on shipboard which would not be suitable for coal bunkers. Other advantages of oil are that it adds about three knots to a vessel's speed and that vessels may be readily refueled at sea from tankers. Using oil fuel also enabled a reduction to be made in the fire room force of more than 50 percent. In the fall of 1912, the keel of the Queen Elizabeth, the first British battleship designed to burn fuel oil exclusively, was laid. She was completed in January 1915, during the first World War about six months after the completion of the first two oil burning battleships, the Nevada and the Oklahoma, for the United States Navy.

As we have previously seen, Germany entered the World War with control over less than one percent of the world's petroleum production as compared with more than 15 percent controlled by Great Britain. All historians have recognized the fact that one of the principal factors which brought final success to the Allies and defeat to the Central Powers was the abundance of oil supplies available to the former and the lack of oil for the latter. Gasoline was available for Allied aircraft as fast as they could be produced, for trucks bringing food, munitions and other supplies to the front lines and for motor ambulances carrying wounded quickly from first aid stations to hospitals and hospital trains in the rear; fast oil burning vessels were being constructed in all shipyards to increase the naval superiority of the Allies and the speed and capacity of ships bearing men and supplies to France. There is but little doubt that the British tank attack at Cambrai on October 18, 1918, heralded the birth of mechanized warfare now so determining a factor in all actions of the present conflict. Under the stimulus of high prices and increased demand brought on by the war, world production increased from 385,345,000 bbl. in 1913, to 503,515,000 bbl. in 1918; of this increase 107,482,000 bbl. was in the United States.

During the World War many countries which had largely relied on coal for a source of power found it increasingly hard to get and consequently were forced to look to other sources for fuel. The rapidly growing American oil industry was not slow to recognize its opportunities and, therefore, began to expand its foreign markets. Oil bunkering stations were constructed in many foreign ports where heretofore coal had been supreme. Lower production costs, lower transportation costs, easier and cheaper handling, and higher heating value per unit of weight all favored oil. It is no wonder then, that after the war the coal industry found many of its markets lost and that industries which had of necessity turned from coal to oil were not inclined to revert to coal. The dawn of the Petroleum Age, heretofore largely evident only in North America, now became world-wide.

The American oil industry which, except for Doheny's Mexican operations, had been represented abroad largely by subsidiaries engaged in transporting, refining and marketing petroleum products, now began to awaken to the necessity for controlling foreign as well as domestic production or facing the loss of markets it had pioneered and developed to the fast growing, powerful, aggressive Royal Dutch Shell combine with its world-wide sources of supply and refining facilities located nearer to populous European and Asiatic markets than was American oil. Just before the War, as previously stated, Britain had purchased control of the Anglo-Persian Oil Company and had geared down Persian production to approximately the requirements of the Royal Navy and the government. British naval vessels were designed to burn this high gravity Persian oil, which required no pre-heating.

The large American oil companies—principally Standard Oil Co. (N.J.) and marketing companies, remnants of the dismembered Standard Oil trust—with interests abroad, realized that they would face heavy losses unless they too could acquire interests in foreign oil fields and compete equitably with Royal Dutch Shell and other British-owned companies. With this end in view the industry sought active diplomatic aid from the government in securing foreign oil concessions. With a somewhat stabilized government in Mexico under President Carranza, several American oil companies entered the Mexican field. By 1921 Mexico's oil production, amounting to 193,398,000 bbl. (25.2 percent of world production in that year) was controlled 26.6 percent by Royal Dutch Shell; 70 percent by American interests and 3.4 percent by Mexican and other capital.

The Standard Oil Company (N.J.) after the dissolution decree breaking up Standard Oil trust in 1911, found itself possessed of extensive domestic and foreign marketing interests, a large domestic refining capacity and with no important producing properties, either at home or abroad, from which to supply them. In order to correct this situation, the company secured control of the Carter Oil Company and the rapidly growing Humble Oil and Refining Company, which had important production in Texas. The company began the invasion of foreign fields through its established refining and marketing subsidiaries abroad—the Imperial Oil Company, Ltd., in Canada, and Romano-Americana in Rumania. It entered the Mexican fields through the Transcontinental Petroleum Company and International Petroleum Company—subsidiaries of Imperial. Through International it secured possession of production in Peru and through Romano-Americana, about a 20 percent interest in Rumanian production.

Although indications of oil were rather widespread in Venezuela, particularly in the Maracaibo Basin, the active development of its oil resources began in 1913, with the acquisition by the Royal Dutch Shell of the Caribbean Petroleum Company and the company's Rafael Max Valladares concession. In 1914, under Shell's direction the Caribbean opened the Mene Grande

Headquarters of the Royal Dutch Shell Group at The Hague, Holland before the war. From these offices orders were issued that profoundly affected the economic development of many remote areas in all parts of the world.

Field on the east shore of Lake Maracaibo and shortly thereafter built a small refinery, sufficient to supply the limited Venezuelan market, at San Lorenzo; in 1915, the Bataafsche Petroleum Maatschappij, erected a large refinery at Willemstad, on the Island of Curacao, a Dutch possession in the West Indies, located about 260 miles from the lake's outlet to the Caribbean Sea and off the Venezuelan coast, for the purpose of treating the great bulk of its Venezuelan production as well as oil shipped from its Mexican fields. In 1924, three Royal Dutch Shell subsidiaries (Venezuelan Oil Concessions, Caribbean Petroleum and Colon Development) produced 7,582,000 bbl. and the British-owned British Controlled Oilfields, Ltd., 1,113,000 bbl. of the 9,042,000 bbl. of oil produced from Venezuelan fields during the year.

With the discovery of the La Rosa field in 1922, other British and American oil companies entered the Venezuelan fields. Among the latter was the Lago Oil Corporation (Cosden interests of Oklahoma) which acquired concessions along the eastern shore of Lake Maracaibo and under its waters. In 1924, control of Lago passed to the British Mexican Petroleum Co., Ltd., owned jointly by Doheny interests and a British shipping group headed by Lord Inverforth; in 1925 Doheny's Pan American Petroleum and Transport Company took over the British interests and all were transferred to a holding company, the Pan American Eastern Petroleum Corporation, controlled by a syndicate headed by Standard Oil Co. (Ind.), created for the purpose of acquiring all of Doheny's foreign and part of his domestic oil operations. In this deal the Standard Oil Co. (Ind.) also acquired Lago's large refinery at St. Nicholas Bay, Island of Aruba, located slightly north of west of Curacao and about 190 miles from Lake Maracaibo. Aruba is also a West Indies Dutch possession. Because of agitation by independents for a tariff on mineral oils imported into the United States and because Standard Oil Co. (Ind.) had no established outlets for crude or refined petroleum products abroad, the company disposed of its foreign oil properties and refineries to the Standard Oil Company (N.J.) in May 1932. The reported consideration was said to have been $50,000,000 in cash to be paid over a four-year period and $96,000,000 in stock of the New Jersey company.

In recent years discoveries by American interests, chiefly by Standard Oil of Venezuela, Consolidated Oil Corp. (Sinclair), Mene Grande Oil Co. (Gulf Oil Corp.), Texas Co., and Socony-Vacuum Oil Co., have strongly intrenched American capital in the Venezuelan oil industry. Production from properties controlled by American companies has now outstripped British and British-Dutch operations and probably soon will amount to as much as two-thirds of the oil produced in Venezuela. Venezuela's petroleum production in 1941 amounted to 227,000,000 bbl., or 10 percent of world production. Only the United States and Russia, with approximately 63 percent and 11 percent, respectively, of the world's petroleum production, now exceed the output of Venezuela's prolific fields.

Although exploration for oil had been conducted in Colombia for many years, it was not until 1918 that commercial production was found. Two large concessions—the De Mares Concession, which embraces a vast region lying east of the Magdalena River between the Sogamoso and Carare rivers and the Magdalena in the Department of Santandar, and the Barco Concession, which occupies a large area in the mountains and foothills at the headwaters of the Catatumbo River, a river flowing eastward into Lake Maracaibo in Venezuela, in the Department of North Santandar—are the present sites of Colombian oil production. Since these areas are far inland, with wild and mountainous country intervening between their valleys and the Pacific Ocean, transportation difficulties have impeded the search for oil in Colombia and the development of many areas where indications of oil have been discovered. Because of the high cost of drilling oil in Colombia, development and exploration of the De Mares and Barco Concessions have been slow.

Two fields have been developed on the De Mares Concession at Las Infantas and La Cira by the Tropical Oil Co., owned by Standard Oil (N.J.) through International Petroleum Co., Ltd. Two fields have also been opened up on the Barco Concession at Petrolea and Rio de Oro which, after passing through many hands and after the expenditure of millions of dollars, now is in the possession of the Colombian Petroleum Company, owned jointly by the Texas Company and Socony-Vacuum Oil Co., Inc. At the present time Colombia's petroleum production comes one-fifth from the Barco Concession fields and four-fifths from the DeMares Concession fields. In 1941 it amounted to some 24,400,000 bbl., about 1.2 percent of world production.

Prior to the World War, German engineers had discovered the vast oil potentialities of Iraq and the route of the much discussed Berlin-Bagdad railroad was unquestionably surveyed with the thought of including Kirkuk and other Mosul oil fields within the area, 20 kilometers on either side of the road, wherein mineral rights were reserved to the builders of the road. In 1912 the Turkish Petroleum Co., Ltd., was formed, owned 55 percent by the Turkish Government, 20 percent by British capital, 20 percent by the German Deutsche Bank and five percent by C. S. Gulbenkian, an Armenian who was a British merchant and citizen and a large stockholder in and director of several of the companies making up the Royal Dutch Shell combine. The operations of the company were not immediately successful and the Government's shares were sold to the newly organized Anglo-Persian Oil Company, thus giving British interests control. In 1916, the British, hoping to get aid for the hard pressed British forces in the Near East, entered into a treaty with France whereby the eastern frontier of the proposed French mandate of Syria was re-established in a position which would give France control over the valuable Mosul oil region. The hoped for French aid failed to materialize, so after the war the British found a large part of their army in eastern Asia protecting a valuable part of the French empire. British efforts to reopen negotiations which would bring the territory again within the British mandate or Iraq were unsuccessful and the British Army was therefore withdrawn, much to the consternation and dismay of the French. With the withdrawal of the British, the Turkish Army marched into Syria, and France and Turkey were again at war. In the peace which followed, the British were in turn dismayed when France granted to Turkey the Southeastern portion of its Syrian mandate, including the Mosul oil fields. The Greeks and Turks had been doing some desultory fighting in Asia Minor since 1920 and Britain, hoping to regain the Mosul area, sent munitions to the Greeks. The French, in turn, supplied the Turks with similar aid so that to all intent the erstwhile allies were at war by proxy over Mosul oil. When the Greeks were driven from the continent a strong nationalist movement for independence was instigated in Iraq. In 1922 an Iraqian army, lead by Anglo-Indian officers entered the disputed area to liberate it from the Turks.

Meanwhile, American oil interests led by Rear Admiral Colby M. Chester and Major General George Goethals of Panama Canal building fame, made a deal with the Turkish Government whereby certain railroads and telegraph lines would be built in Turkey in return for mineral concessions in the area embracing 20 kilometers on either side of the right-of-way. Since the Chester concession would have "stolen all the gravy", the French and British interests compromised their dispute and united to fight this new threat from American oil interests. In July, 1923, the Treaty of Lausanne was signed and the Iraq-Turkey frontiers were re-established with the coveted Mosul oil fields once more in Britain's realm. Britain, of course, would grant no recognition to the Chester interests, and when the State Department withdrew its diplomatic support thereof in its efforts to bring about British cooperation on the Dawes plan for the settlement of the German reparation issue, Admiral Chester's claims became valueless.

Final disposition of the Mosul fields in Iraq came with the revival of the old Turkish Petroleum Company, Ltd., formerly controlled by Anglo-Persian, Royal Dutch Shell and French interests. Needing some real money, and perhaps realizing that the Chester deal which had been well publicized in the United States had not left a good taste in the mouths of the American people, certain American interests, which have since all passed to the Standard Oil Co. (N.J.) were cut in on the production from the Mesopotamian oil fields. In order to bring Mosul oil to European and world markets it was first necessary to construct a pipe line from the fields over the intervening mountains and desert to the shore of the Mediterranean Sea. Here again the British and French oil interests were at outs as each insisted

that the Mediterranean terminal should be at a port in its mandated territory. To satisfy both parties, a bifurcated line was laid, one terminating in the French Syrian port of Tripoli and the other in the British Palestine port of Haifa.

Thus was ended, for the time being at least, the wars and diplomatic intrigues involving Mosul oil—the final outcome being control by the British-owned Anglo-Persian of 23¾ percent, by the Royal Dutch Shell of 23¾ percent, by French interests through the Compagnie Francaise des Petroles of 23¾ percent, by American interests through the Near East Development Co. (owned by S. O. (N.J.), of 23¾ percent, with the remaining five percent of the company owned by Gulbenkian. In 1941 Iraq, chiefly from wells in the Kirkuk field, produced 9,875,000 barrels of petroleum, a little over 0.4 percent of world production. This production does not represent the capacity of the fields but rather the limits of the carrying ability of the pipe lines to the Mediterranean plus minor domestic consumption.

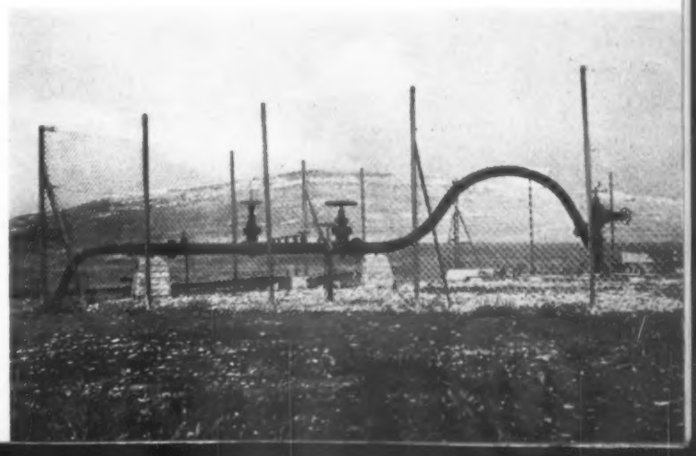
In 1913, as previously noted, the Royal Dutch Shell interests entered the oil fields of the United States by acquiring control of the California Oilfields, Ltd., and Roxana Petroleum Company. The Shell interests in the United States grew rapidly and by 1919 ranked tenth among United States oil producers, with a production of 9,164,860 bbl.; by 1924 the Shell-Union Oil Corporation had advanced to leadership with a production of 40,684,182 bbl. or 5.7 percent of the country's petroleum production. While Shell was allowed freely to expand its operations in the United States, no similar treatment was extended to American-owned oil companies seeking to gain a foothold in the producing areas of British and Dutch colonial and mandated possessions. The agreement signed at San Remo, April 24, 1920, by Britain and France wherein certain reciprocal arrangements were made covering the exploration for and exploitation of petroleum in Rumania, Galicia, French and British colonial and mandated possessions, to all intents and purposes closed the door in these areas to American oil interests and particularly irked American companies and the State Department in its efforts to support them. The American oil industry finally gave up trying to get foreign oil concessions through the State Department's diplomatic channels alone, and took a more forceful line of action, through the Congress of the United States. Bills had been introduced in Congress and strongly pressed for several years to permit the leasing of public lands for oil and gas development and large areas of possible oil lands had been withdrawn from agricultural and mineral filings, from time to time, pending their classification. When the leasing act was finally passed and approved, February 25, 1920, Section 1 thereof contained as its final proviso the following language:

"And provided further, That citizens of another country, the laws, customs, or regulations of which, deny similar or like privileges to citizens or corporations of this country, shall not by stock ownership, stock holding, or stock control, own any interest in any lease acquired under the provisions of this Act."

On June 5, 1920, the Merchant Marine Act of 1920 was approved; Section 27 thereof provided: "No merchandise shall be transported by water, or by land and water, on penalty of forfeiture thereof, between points in the United States, including districts, territories, and possessions thereof embraced within the coastwise laws, either directly or via a foreign port, or for any part of the transportation, in any vessel other than a vessel built in and documented under the laws of the United States and owned by persons who are citizens of the United States. . . ."

These two acts threatened seriously to curb the growth of Shell in the United States since nearly all of the oil companies operating in the Mid-Continent and California fields which the Shell might absorb were interested in public land leases and in intercoastal trade. Shell company tankers could no longer engage in intercoastal or trade between continental United States and its foreign possessions, which in effect barred Shell from the markets these areas afforded. Among other bills introduced to curb Shell's activities in the United States were the Curtis Bill, introduced in the 66th Congress, which would have denied to citizens or subjects of any country which did not permit citizens of the United States like privileges within its borders, possessions or dependencies, to hold either directly or indirectly any right, title or interest, in any mine or mineral deposit, including petroleum, in the United States or any of its dependencies, or to act on the board or in any managerial capacity whatsoever in connection with any company having any right, title, or interest whatsoever in mines or minerals in the United States or its dependencies so long as similar restrictions remain in force in any law or regulation or in any contract, lease, or other agreement to which the government of the foreign country or any of its officials or representatives was a party. Senator McKellar (Tennessee) also introduced a reciprocity measure pertaining to petroleum which would have denied to foreign-owned oil interests controlling oil operations in the United States, its territories or dependencies, the privilege of exporting any crude or refined products or petroleum unless American-owned oil companies had reciprocal operating privileges in the nation, its colonial possessions, mandated territories and spheres of influence in the nation whose nationals owned American producing, refining or transportation facilities. These bills showed conclusively the temper of Congress and gave notice that it would take steps to secure reciprocity in oil matters from Britain and Holland or force British and Dutch interests out of the American industry and markets. Since the principal oil producing areas, outside of Persia and Burma, where American oil companies had sought concessions, were in Mesopotamia and the Dutch East Indies, the British and Dutch governments soon discovered ways and means by which American companies could secure concessions and conduct their business in these colonial possessions. As a result the Standard Oil Company (N.J.) subsidiary, Nederlandsche Koloniale Petroleum Maatschappij, which formerly had conducted small operations on private lands in Palembang and Java, was able to expand its operations in the Dutch East Indies into Sumatra and increase its production from 80,000 bbl. (0.33 percent) in 1925 to nearly 30 percent of the 60,830,000 bbl. produced in the islands in 1940. As previously noted, American interests were also permitted a 23¾ percent interest in the reorganized Turkish Petroleum Company's operations in Iraq, which have since grown to important proportions before the present war.

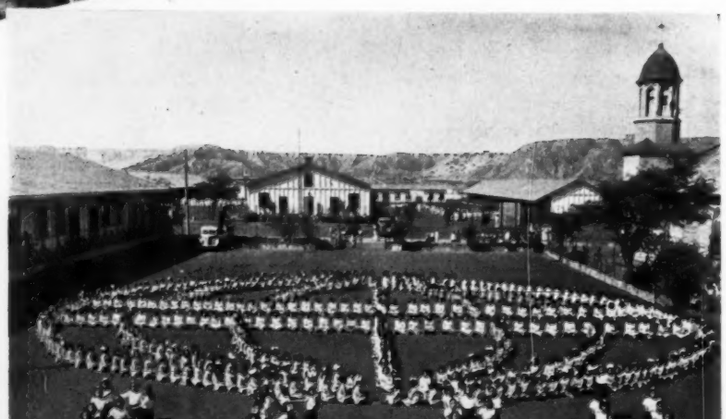
The principal purpose of this article has been to show that the oil business for half a century has had extensive political as well as commercial ramifications. As stated at the beginning, we believe the value of oil resources to the industrial lives of nations has become of such prime importance that no country without such resources can really hope to compete successfully in international commerce, in manufactures and at the same time pay tribute to its competitors on the oils it requires. For the same reasons ocean and air borne commerce would likewise be at a disadvantage in international competition without ample supplies of petroleum fuels and products at their command. In the present war we feel that lack of petroleum supplies has been an important and controlling factor in leading Germany to strike with her full forces despite the costs and to bring actions to an immediate issue before large quantities of her available oil supplies were used up. Without continuing oil resources it appears impossible for Germany to consolidate her gains in Europe and successfully resist the attacks of the United Nations. To this fact may be ascribed Germany's desperate attempt to break through on the Southern Russian front in an effort to reach the Caucasus before the summer campaign ends.



A modern flowing well near Kirkuk in Iraq. Development of this field represented the cooperation of government and private industry in England, France, Holland and the U. S.

OIL BUILDS MODEL TOWNS

Work of the International Petroleum Company in Providing Modern Housing, Sanitary, Educational and Recreational Facilities, Yields Good Results at Talara and Negritos.



It is not sufficient for an oil company to provide food and shelter for the workmen in some of the isolated oil camps such as that of the International Petroleum Company at Talara, Peru. The families of the workers must be educated and trained and facilities provided for sport and physical exercise. Above, boys march in the sport stadium while the girls' school exercises in the center of the camp. Barren hills, typical of this part of the west coast of South America may be seen in the background of the lower picture.

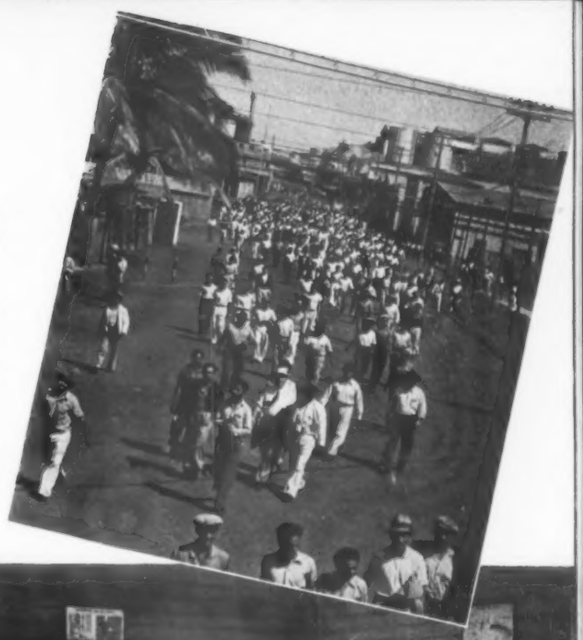
WITH SOME NOTABLE EXCEPTIONS oil has a way of making its presence known in places remote from centres of population and established lines of transportation. Sometimes new fields are deep in tropical jungles, surrounded by desert wastes or shut off from communication by rugged mountain ranges. Since oil is where you find it those who undertake the development of such fields are under the necessity not only of moving the machinery and equipment to almost inaccessible points and providing there the facilities for operation but they must also build homes, lay out towns, build streets and sewers and lighting systems, establish schools, erect hospitals and shops and provide recreational facilities for workers and their families.

Where operations are extensive some of these settlements attain the proportions and appearance of good sized cities but no matter what their growth may be they are invariably referred to in the oil industry as camps. Some of these "camps" with well paved streets, attractive public buildings and other appurtenances of modern urban communities are a source of considerable surprise to visitors who view them for the first time.

A good example of what can be done to establish comfortable and pleasant living facilities in a location possessing few natural attractions is Talara, chief oil port of Peru, site of the largest refinery on the West Coast of South America and outlet for the oil production of the LaBrea and Parinas fields. While oil has been produced in this district for upward of fifty years its chief development dates from 1914 when the properties were acquired by the International Petroleum Company. At that time the yearly production of roundly 100,000 bbl. was treated in a small skimming plant and the number of employes to be cared for was relatively few. In succeeding years the scope of operations has steadily increased; some 2,500 wells have been drilled, production has risen to around 10,000,000 bbl. yearly and a well-equipped modern refinery with a daily capacity of 19,000 bbl. is in operation. As an accompaniment of this expansion the numbers of workers has steadily increased and two flourishing towns, Talara and Negritos, have been built up with a combined population of approximately 30,000 which remains fairly stable.

One of the first steps taken by the International Petroleum Company after it took possession of the property was to lay out new townsites in or-

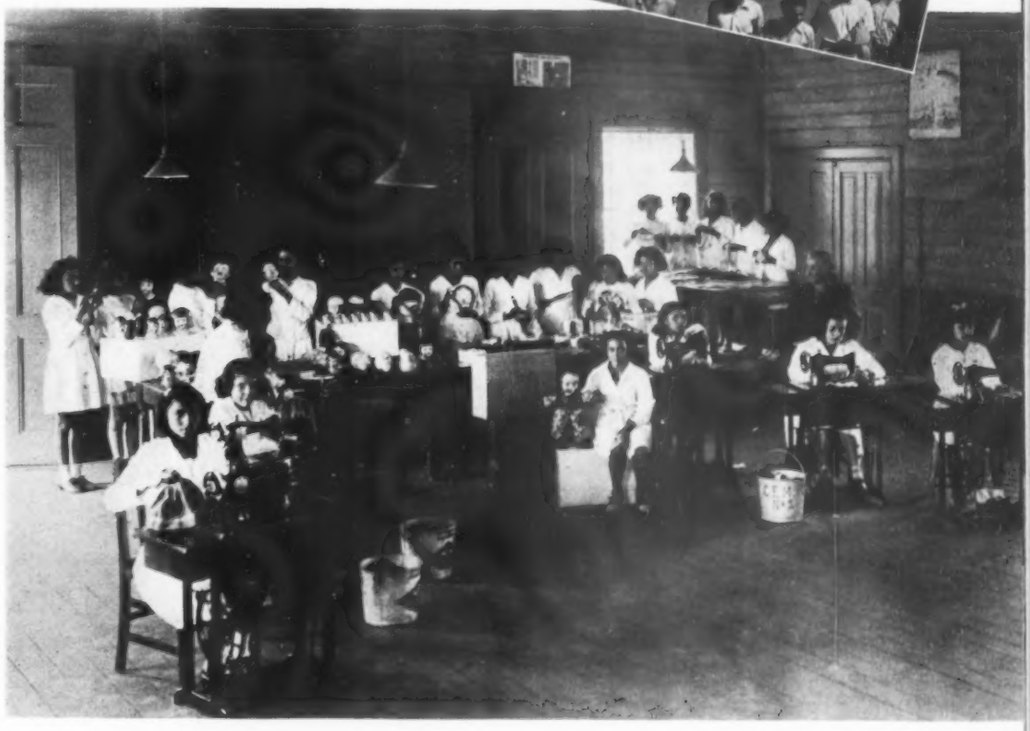
ON PERUVIAN DESERT



Right, at the end of the day workmen leave the Talara refinery to return to clean comfortable homes after a day's work. The entire camp was constructed in what is virtually a desert.

Below, manual training is taught in the girls' school maintained by the International Petroleum Company. Company schools must meet the standards established by the Peruvian Ministry of Education.

Bottom, superior medical attention is provided for workmen and their families; here may be seen convalescents resting outside the company's hospital.



der to provide improved housing with all necessary facilities for its workers. Everything requisite to the health, comfort and social activities of employes and their families had to be provided and in order to do this in the most effective manner a comprehensive program of development was drawn up and adopted.

One of the problems first in order because of its urgency was the establishment of a safe and reliable water supply. In a region where rain falls only once in twenty-five to thirty years this is a matter of importance. In the early days the few residents had been compelled to depend upon distilled sea water for drinking purposes. Soon after its advent, however, International took steps to establish a fresh water supply piped from the river Chira, twenty-five miles to the southward. The water is pumped from the river to large sedimentation tanks, passed through sand filters, treated with chemicals for further purification and finally chlorinated to kill any germs that it may contain. Twice a month the water undergoes chemical and bacteriological tests to make certain that its purity is being fully maintained.

As a further safeguard to the health of employes and their families the company from the beginning has paid careful attention to the maintenance of healthful community conditions and the provision of adequate medical care. One of the first tasks undertaken twenty-five years ago was the institution of a thorough system of sanitation, the elimination of foci of infection and the taking of other measures conducive to the desired result. The company put up two hospitals, one in Talara and the other in Negritos, the populated centres of most importance in the oil zone. Subsequently it established six medical dispensaries in the less populous districts. In these hospitals and dispensaries from 600 to 800 patients are treated daily. Each of the hospitals is equipped with the most modern installations, including a complete range of surgical instruments, an X-ray set, pharmacies, and a total of 190 beds. Eight doctors and a diplomaed laboratory and X-ray technician are in attendance, assisted by eighty-four nurses who give all possible care to their patients.

Workmen receive free medical attention, at their homes or in the hospitals, are operated on free of charge and pay nothing for medicine. This service and the up-keep of hospitals and dispensaries, involves a yearly expenditure of over $250,000, United States currency. Every three years the

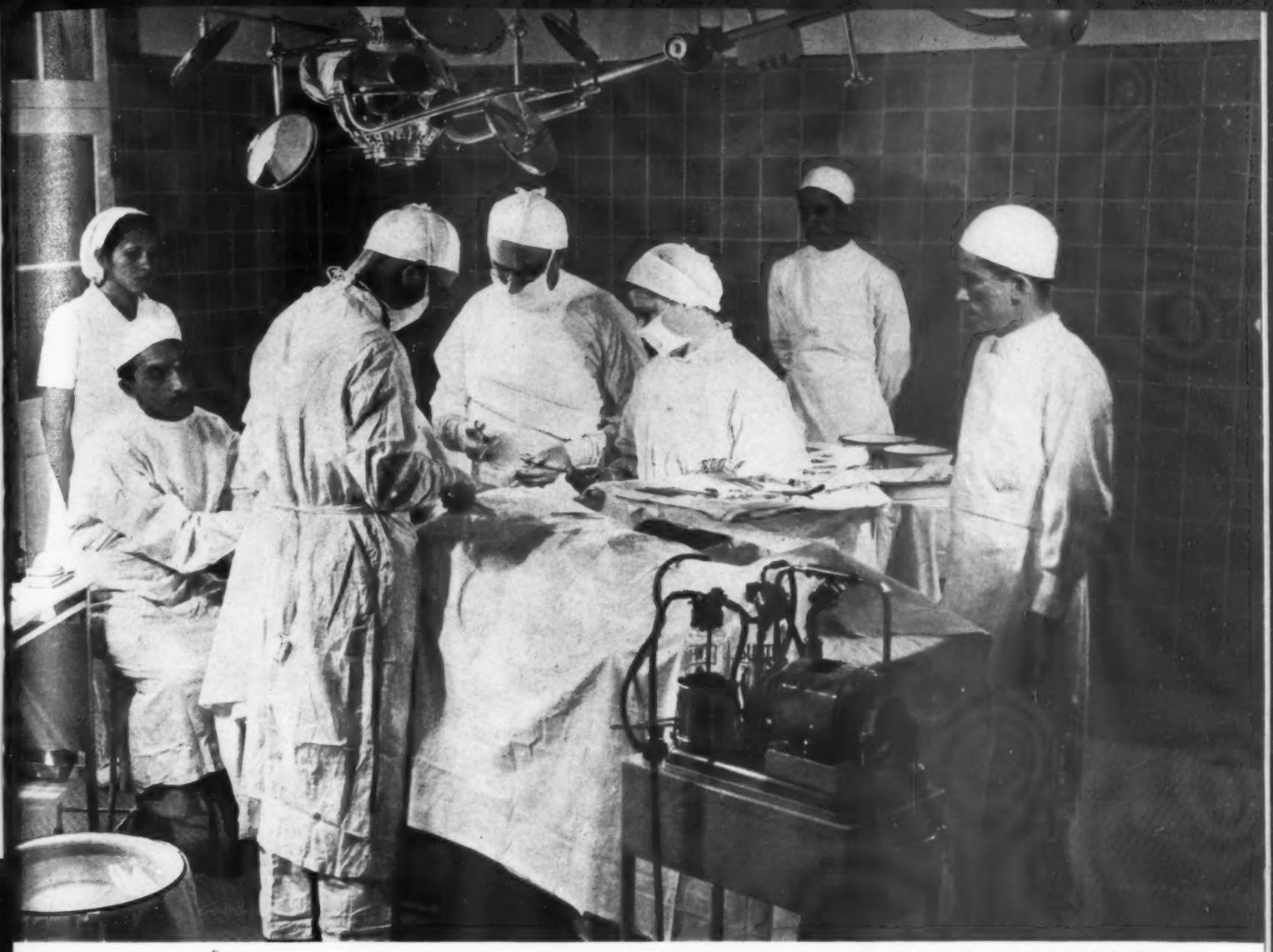
One of the oldest employees of the International Petroleum Company at Talara: Guillermo Clavijo del Rosario, a mason who has worked at Talara since October 15, 1890, displaying a slab of artificial marble that he has made for a stairway.

company doctors vaccinate the whole population against small-pox and typhoid, taking in the meantime every precaution to prevent epidemics. Under the conditions outlined, the company keeps the workers in its service in the very best conditions of health, the only way to safeguard its labor. The towns of Talara and Negritos are likewise the object of intensive sanitary attention. In this respect, the health conditions of the oil zone under the charge of the International Petroleum Company compare favorably with any other place in the world.

Shortly after beginning operations the International established schools in the Talara and Negritos fields. At present there are eleven schools and 125 teachers, with a total of 4,500 children registered. Three night schools are also kept up, with an attendance of 65 pupils and seven teachers. The up-keep of all these schools represents an expense to the company that amounts to approximately $75,000 yearly. An inspector, graduated from a normal college and appointed by the Bureau of Education, is responsible for the supervision of education, which is given under the official programs of the Ministry of Public Education. The teaching staff is also appointed by the Bureau of Education, and the company, in addition to paying their salaries, gives them a bonus and provides housing, light, water, and other facilities at its own expense. All children of those in the company's service, as well as those of the government employes and local residents, receive free schooling, including the provision of books, copybooks, pencils, inkpots, pens, rubbers, chalk and material for drawing and manual work. The school premises, which are large, suitably situated and well ventilated, have good classrooms, asphalted play yards, shops for handicrafts, fields for athletics and sport, tennis courts and modern hygienic services. The furnishing is complete, with individual desks, wall blackboards, maps, pictures for objective teaching, tools, and in general, all kinds of equipment for manual work, including sewing machines, carving tools and poker-work sets. The cultural and artistic phases of education also receive attention. The schools have pianos and radios, and artistic evenings are frequently organized on the occasion of the celebration of the more important national holidays. Athletics and physical culture are fostered by gymnastic training, games and contests for school championships under the guidance of the professors of physical culture. Careful attention is given to the health of school children. Medical and dental care is provided and physical examinations take place at regular intervals.

Talara and Negritos are progressive towns, well in advance of most industrial communities. They have broad well paved streets that are kept always clean and in good condition for both wheeled and foot traffic. There are no hovels or slums but all the homes are well built, well kept and equipped with the lighting, water and sewerage connections essential to modern standards of comfortable living. In addition to their wages or salaries employes are provided with dwellings and cooking fuel as well as with medical care and education for their children entirely free. The International Petroleum Company does not forget that workers need healthy recreation after working hours and, for this purpose, has built special premises for centres of social life, playing fields and swimming pools. A noteworthy addition to recreational facilities is the stadium just erected at Talara with grandstand capacity for over 6,000 persons. The company also maintains

A large supply of drugs and medical equipment must be kept on hand to safeguard the health of the oil workers as indicated by this picture of the Talara hospital medicine and drug deposit.



A competent medical staff with the most modern equipment cares for the health of the Talara workmen at the International Petroleum Company's camp. As indicated in the illustration the operating room includes all the latest medical equipment and is available at all times to workmen and their families.

football and baseball fields of regulation size and an athletic track. Needless to say, there are comfortable cinemas where the best films and latest news-reels to come into the country are exhibited. To allow the workmen and their families to practise their religious beliefs, churches have been built where Catholic services are held.

In order that the people can supply their wants in the way of food and other essential commodities, the company has not only built sanitary markets but maintains two well-stocked commissariats, operating on a non-profit basis, for the supplying of food and clothing at low cost. While certain items are imported, the bulk of the articles consumed by the company's employes are obtained in the country, it being the company's policy to support local industry whenever possible. Fresh meat is sold by independent butchers at sanitary stalls provided by the company, prices being regulated by the government. A fleet of fifty-odd fishing boats from Talara and Negritos provide the local market with fish, though at times there are shortages as a result of unfavorable fishing conditions. Supplies of fresh vegetables and farm produce are brought in from the Chira river valley and sold in the local markets. Rice, one of the main articles of food, is usually to be had in sufficient quantity to supply requirements, but for reasons connected with the war a distinct shortage has developed, making it necessary for the government to control distribution. The company, in cooperation with governmental agencies, supervises all food supplies, in order to maintain prices at reasonable levels. The enlightened policy pursued by the company in relation to its employes undoubtedly has helped it to maintain a stable supply of labor, fond of its jobs, with which it maintains the best relations. Out of the five thousand Peruvian employes and workmen in the company's service more than one-third have completed ten years of unbroken employment; the number of those who have been with it since the commencement of its activities in 1915 runs into the hundreds. Labor disputes are practically unknown to the company, for it goes out of its way to carry out the legal rulings in favor of the working classes. The company takes particular satisfaction in the capacity and competency of its staff. The work done by Peruvian mechanics in the Talara and Negritos shops, where delicate machinery parts have been and are being made, from the casting of the iron to finishing off the part, are a source of legitimate pride to Peruvian industry.

Besides the activities mentioned the International Petroleum Company acts in many other ways to discharge the duties of good citizenship and to aid the workers in its employ to improve their positions and earning ability. As part of its educational service and with a view to fitting Peruvian employes to become skilled technicians the company grants scholarships to promising pupils leaving its schools so that they can go to Lima to finish off their studies. Scholarships also are awarded to graduates of the Lima School of Engineering enabling them to acquire advanced technical training in the United States or Canada.

WAR IN EUROPE, the requirements of Lease-Lend and finally the entrance of the United States into the war stimulated the demand for steel in this country to unprecedented heights. In the Pittsburgh area, as elsewhere throughout the country, furnaces that had long been idle sprang into life, surplus capacity was strained to the utmost and every facility that contributed to the production of all-important steel was overhauled and reappraised as to maximum capacity. By the summer of 1941 demand had far outrun producing capacity with no prospect of an early let-up in the pressure of demand. Among its other far reaching effects, the vastly increased tempo of operations threw a considerable strain transported gas from the West Virginia fields to the Carnegie-Illinois Steel Corporation's mills in Pittsburgh had a capacity of 51 million cubic feet of gas per day and was being operated at maximum capacity. It was foreseen at this time that additional fuel would be required by the mills to meet the growing demand for steel. In fact, 15 million cubic feet per day of additional gas would be needed before December 15, 1941. Consequently authorization was obtained by United Fuel Gas on September 16, 1941 for the construction of an 1800 hp. compressor station on the line two miles from Smithfield, West Virginia. On the very day the authorization was obtained orders were placed with Clark Brothers ment, all the more remarkable because of the difficulties of obtaining anything like reasonable delivery of materials at that time. With D. S. Keenan, president of Carnegie Natural Gas Company, expediting shipments and delivery and H. M. Baker, chief engineer of the United Fuel Gas Company supervising all work on the project it was completed in the record time of 80 days from September 16 when orders were placed to December 5 when the station was declared ready for operation. Actual operation started on December 7 and has continued at maximum capacity every day since that date. The operation of this compressor station increased the capacity of the line by the required 15 million cubic feet giving the

COMPRESSOR STATION ERECTED IN 80 DAYS INCREASES PIPELINE CAPACITY THIRTY PERCENT

To Meet Wartime Demand for Steel, Pittsburgh Mills Required Increased Gas Shipments from West Virginia —Equipment and Erection of 1800 hp. Compressor Station in Record Time Increased Line Capacity by 15 Million Cubic Feet Per Day

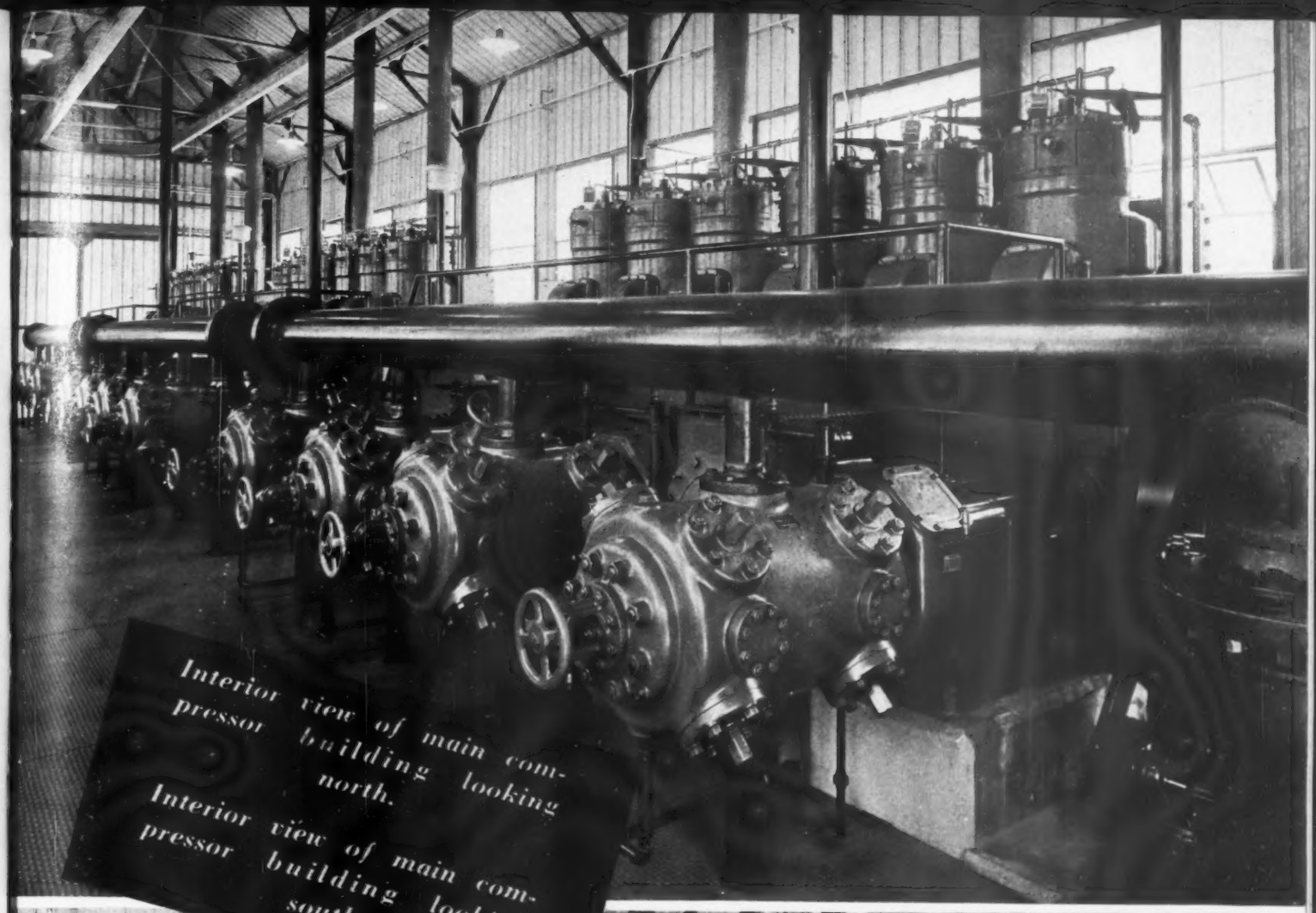
D. S. Keenan,
President, Carnegie Natural Gas Company

on the transportation facilities of the natural gas industry of West Virginia which supplied fuel to the steel mills of Pennsylvania. As an example of the speed and efficiency with which this emergency was met and the flow of gas to the steel mills maintained at the increased rates required, the construction of a compressor station by United Fuel Gas Company on their line to the Carnegie-Illinois Steel Corporation's plant at Pittsburgh in record time as described in this article furnishes an outstanding illustration.

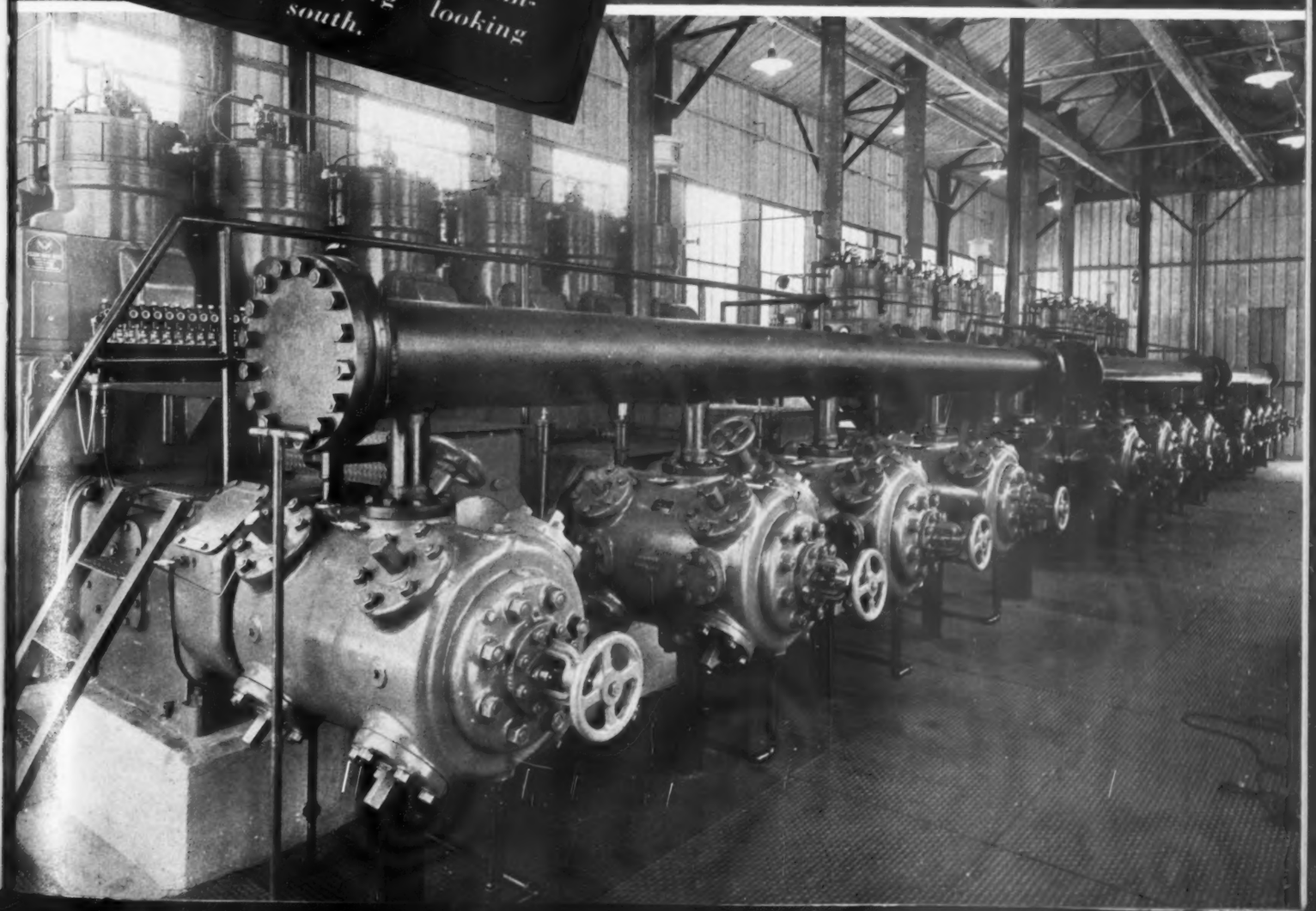
In September 1941 the 16 in. main transmission line of the United Fuel Gas Company which Company for three 600 hp. main compressing units and the site for the station was obtained approximately mid-way on the main transmission line. Excavation was started for construction of the compressor station three days later.

In view of the importance of the additional fuel to the steel industry and thus indirectly to the war effort, high priorities were obtained on all the materials required and the first of the three main compressors was delivered by Clark Brothers on November 14, the second on November 17 and the last on November 22, constituting a record in the construction of such heavy equipline a maximum capacity of 66 million cubic feet per day delivered to the Pittsburgh mills.

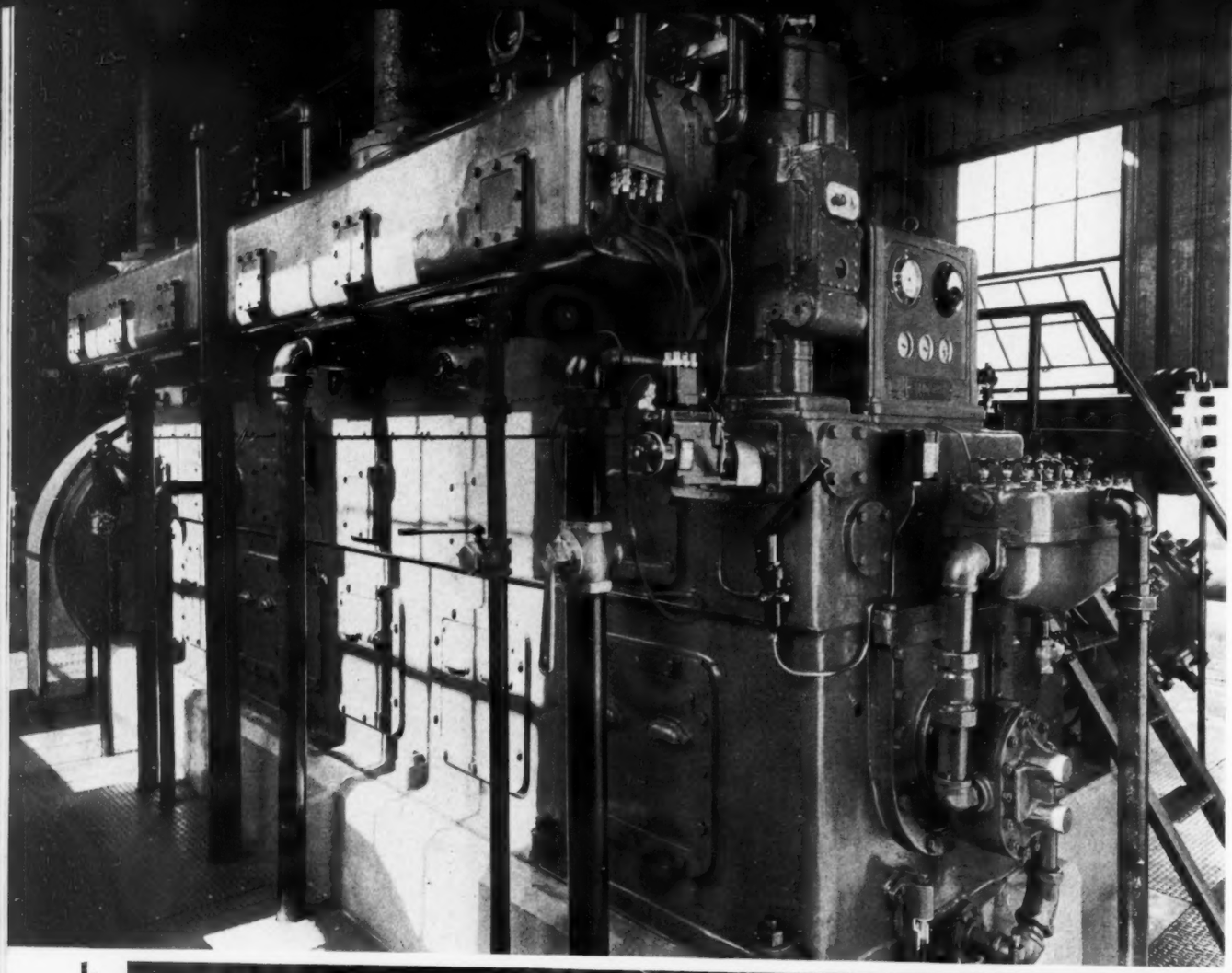
Several detailed views of the station are shown in the accompanying illustrations. The equipment consists of three 600 b.hp. Model RA-6 super two cycle, right angle gas engines operating at 300 r.p.m. These engines are furnished by Clark Brothers and each have six 14 in. bore by 14 in. stroke power cylinders direct connected to the double acting compressors which are four cylinder models having an 8½ in. bore by 14 in. stroke. Each of the main units is equipped with a lubricating oil filter and cooler. McCord Lubri-



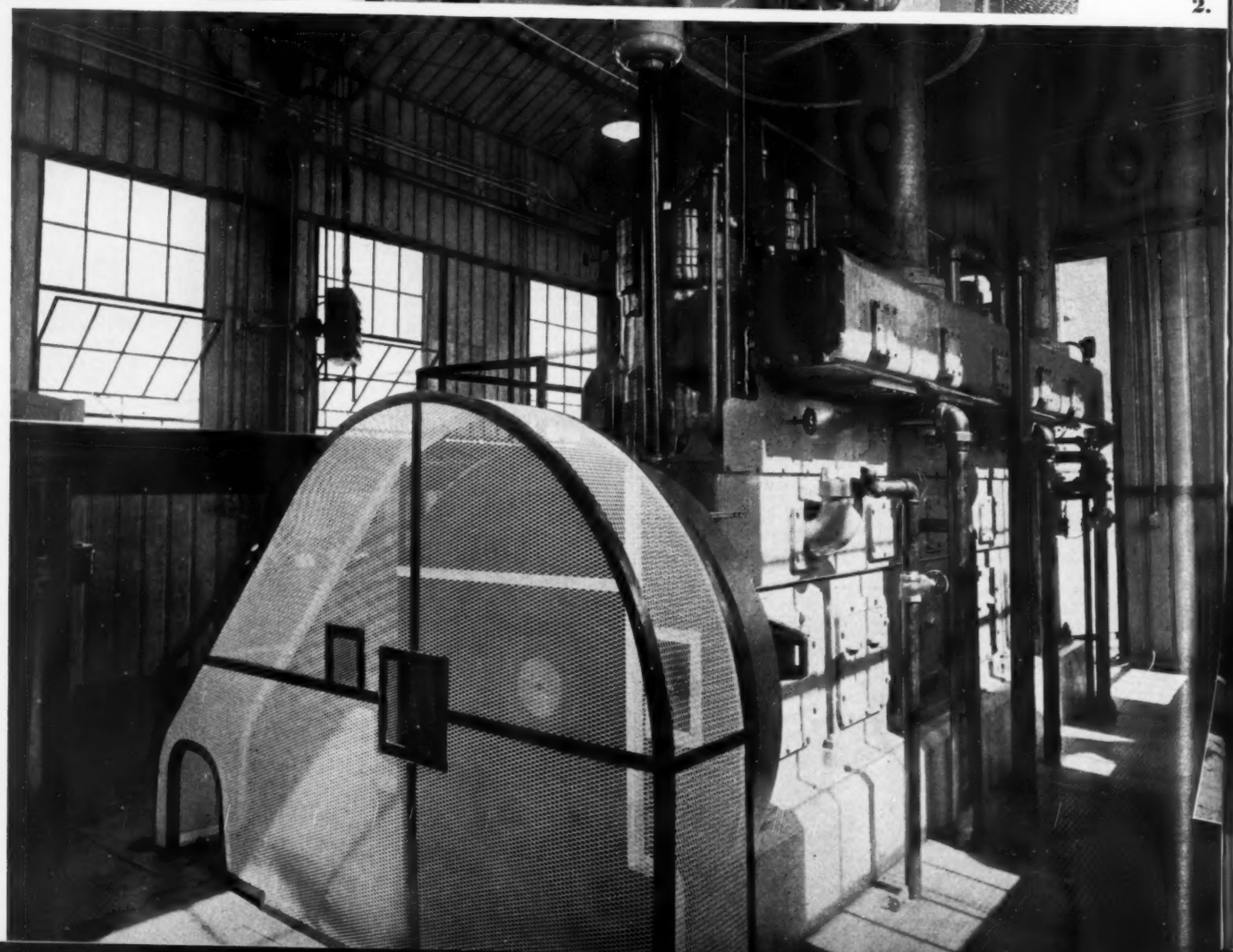
Interior view of main compressor building looking north.



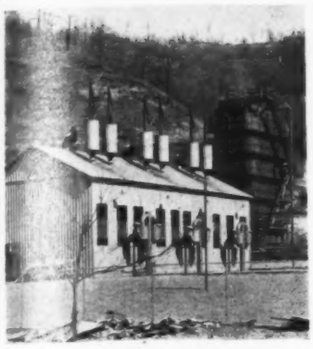
Interior view of main compressor building looking south.



1.



2.

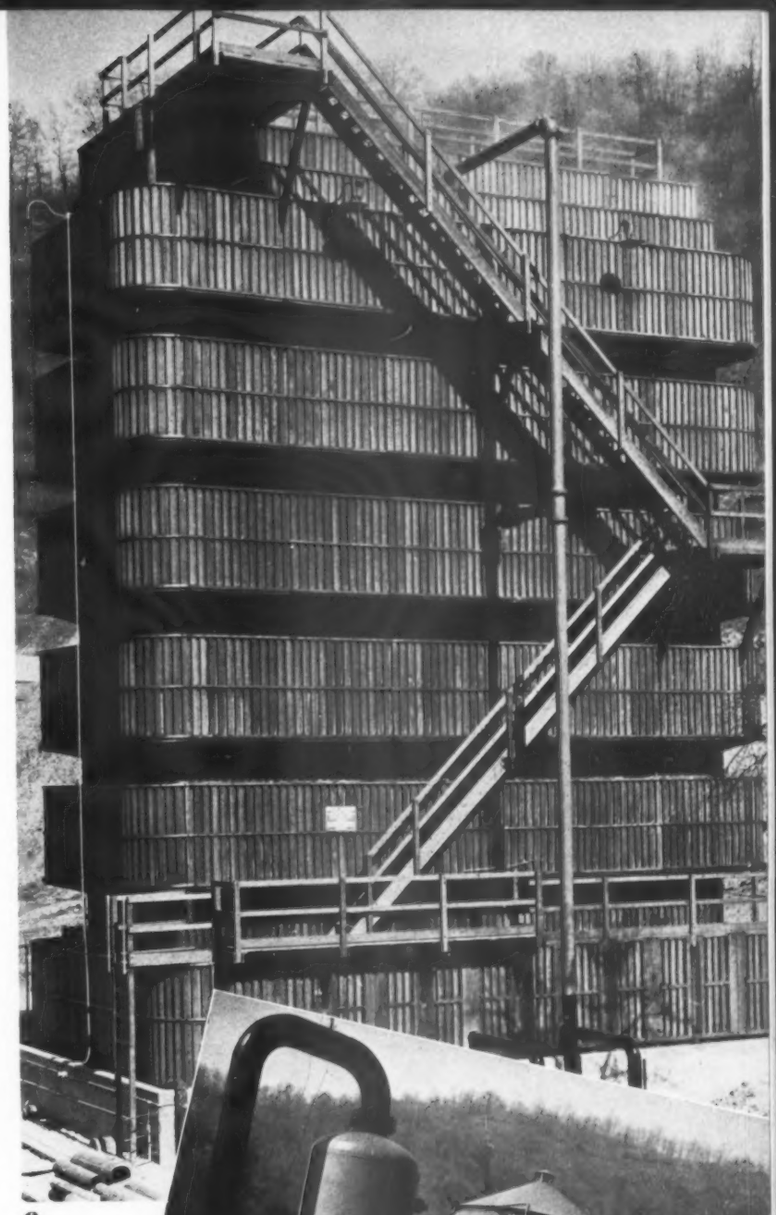


7.

cators, an overspeed stop and scavenging air by-pass control. In addition they have V-belt driven circulating water pumps mounted on slide rails, exhaust mufflers and oil bath type engine intake air filters. These units are housed in a Butler steel building on concrete foundations measuring 26 ft. by 78 ft. by 18 ft.

In a second Butler steel building on concrete foundations two Cooper-Bessemer GSD two cylinder, 60 b.hp., two cycle vertical gas engines operate at 550 r.p.m. These are connected by V-belt to two 40 kw. packaged alternators to operate in parallel with the duplicate unit. Other equipment in this building consists of a 20 hp. electric driven auxiliary water pump, an air starting compressor driven by a gas engine and a gas fired steam boiler for heating. Lockers and washrooms are located in this building.

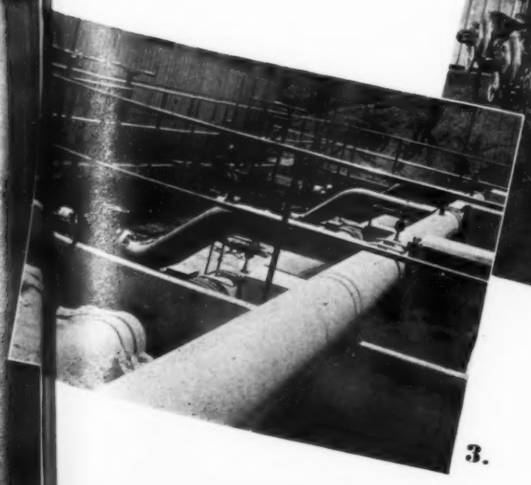
Outside, as revealed in one of the accompanying illustrations, is a Fluor Model 6-XA-15 cooling tower mounted on a five foot concrete base; gas cooling equipment consists of four Griscom-Russell bentube sections located in the bottom of the cooling tower. An open type of water system is used; water is pumped from the engine jacket to the top of the cooling tower flowing downward by gravity over the tower and the bentube sections back to the water jackets. Make-up water from near-by Fishing Creek is sand-filtered and chemically treated before being pumped to the cooling tower basin. Gas entering the station is conditioned by a 60 in. Blaw-Knox scrubber. As a result of a ten-mile extension of the telephone lines during the job the station enjoys the convenience of a direct connection with the United Fuel Gas Company's Charleston office.



6.

5.

4.



3.

1. 600 b.h.p. Clark angle unit from rear.

2. 600 b.h.p. Clark angle unit from flywheel end.

3. Exposed type gas piping system.

4. 600 b.h.p. Clark angle unit from compressor side.

5. Blaw-Knox gas cleaner and oil settling tanks.

6. Fluor cooling tower.

7. Exterior of main building with cooling tower in background.

HULL DESIGNS

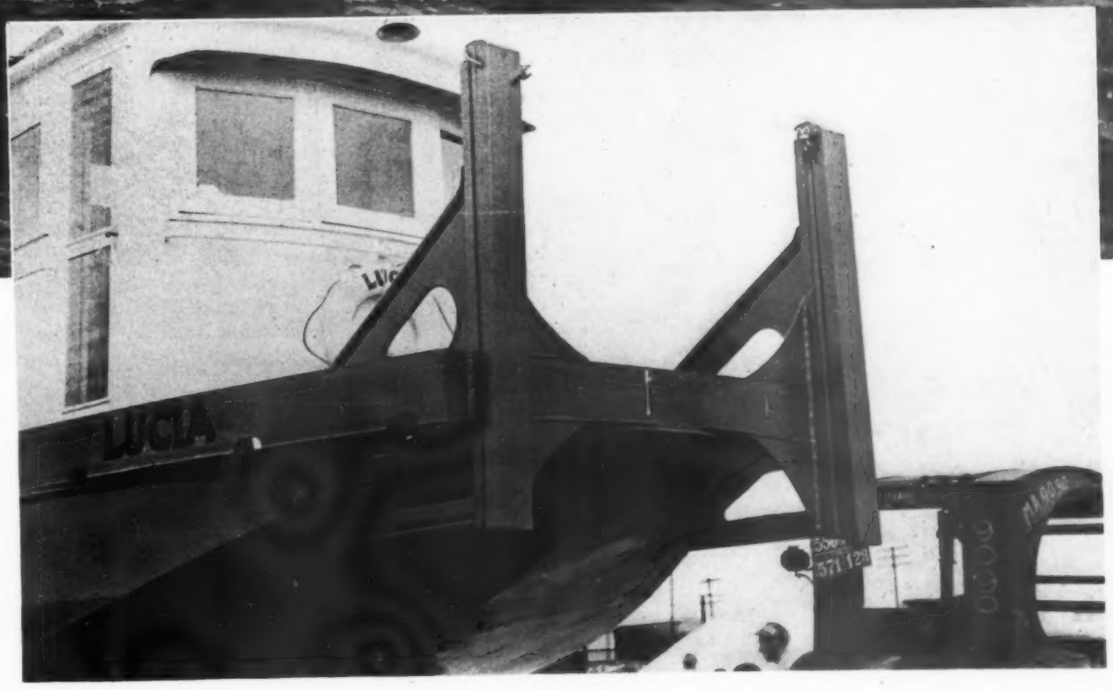
Developed for Geological Parties Serve Armed Forces

By Warren Gleason

OIL, OF COURSE, is so firmly entrenched in the public understanding as an essential ingredient of national defense that any mention of the significance of the oil industry to the country's military and naval welfare seems like old news and quite as uninteresting as last week's headlines. Nevertheless, there is one angle which has received little publicity; not that it is any secret, but that it simply has passed unnoticed. That is the influence upon small boat construction for which the oil companies have materially been responsible; in fact, the stringent requirements of the oil explorers for proper boats, and the profitable business given by them to one builder producing suitable craft, have materially been responsible for the development and growth of one of the most outstanding defense activities in the country during the present emergency.

As one executive of a major oil exploration group told the writer, "In our work, without proper boats we simply would not know how to operate. Much of our exploration work is conducted in shallow lakes and marshy country and sometimes in waters at some distance offshore. Boats are an indispensable feature of our job. And not any boat will do our work. Reliability of course is a consideration. But ahead of reliability comes the fact that a boat, to be of any real use to us, must take us exactly where we want to go. Shallow, muddy waters, generally full of weeds and drift and trash; bayous and streams narrow and twisting, choked with snags and sunken logs; such conditions are everyday affairs but are enough to bar most stock boats from our service. Not that they are not good enough boats in their way, but they are not of the design to carry us into some of these practically impassable swamps and then bring us home."

All of which makes sense. The expense of a party of 20 or more men engaged in gravity-meter and seismograph survey work will run to fourteen or fifteen thousand dollars a month. Delay is an expensive matter from a maintenance angle alone; entirely aside from the fact that time is generally of the essence of the contract. Water parties for exploration purposes cannot afford to be held up by transportation failure. For many years, no boats seemed to be available with the ideal qualities of operating in a heavy dew and at the same time possessing any strength. Light draft meant light weight and flimsy construction, which in turn meant disaster if a log happened to be in the way. Power plants, too, were still heavy affairs in the larger horsepower ratings. Along with development of higher-speed and lighter motors with higher compression ratios, however, boat builders here and there were also experimenting. In the gay days of prohibition a good many boatyards built boats which were never intended to haul potatoes; there were certain cash customers willing and able to pay well for boats which could perform miracles and therefore the reprehensible bootleggers should receive a few orchids for furthering boat design. Craft began to appear which had some of the features most urgently desired



Above: A fleet of Eureka Navy landing boats skimming the surface of the water like a swarm of mosquitos. This unusual type boat was enthusiastically accepted by the Army, Navy and Coast Guard.

Right: View of the spoonbill bow of the "Lucia," a steel river boat built for the Texas Company for use in South America.

Mexican Petroleum Company's steel tug "Ganso" being launched prior to drive-away delivery from New Orleans to Mexico.

Below: Eureka model landing boat for the U. S. Navy with pair of machine gun mounts in the bow. These hulls are the same essential model as supplied originally for oil exploration use, with some refinement changes and increased dimensions.

On trial runs these torpedo boats are put through their paces to prove their ability to hurdle floating logs, ignore weeds and obstacles, be landed or beached anywhere.

by the oil explorers; however, the real puddle-jumpers had not yet made their debut. About 1935 and shortly after, however, some strange craft made their appearance in Louisiana. Constructed by Higgins Industries, Inc., at their plant on St. Charles Avenue in New Orleans, these boats had somewhat the appearance of a shovel-nose or spoonbill scow blended with the pirogue of the bayou country. Scows were hitherto never highly regarded as speedboats, yet these new boats seemed to be able to step along in the water. A few were built for river use and from their performance the builders suddenly realized they had something.

Demonstration of boat performance savored of circus exhibitions. Boats travelling at twenty and thirty-mile speeds headed full throttle at floating logs and drift, hurdled and wallowed them over and through them. Running in less than a couple of feet of water, boats tore in toward a concrete step-type sea-wall and climbed up the thing until they were virtually out of water, and then shoved back afloat, proceeded to speed away unharmed. Demonstrations and trials in narrow, shallow creeks showed that these boats could be landed or beached anywhere, that one of them could be turned around merely by heading it into a bank onto which the bow would climb, then with the gear lever still set in "forward," the rudder hard over and gas given to the motor, the propeller would push the stern around until the nose left the bank and the boat would be turned completely and quickly, though the width of the creek might be actually less than the boat's length. As for weeds and other obstacles, these boats ignored them utterly; weeds did not seem able to foul the propeller and as for drawing little water, these novel road-runners seemed actually to wedge themselves off the bottom. As a matter of fact, that is what did happen. What little water there was, was caught under the spoonbill bow and the after section of the boat simply climbed up on it. Floating drift was largely thrown away from the stern; any drift passing under the hull was deflected by the bronze skeg protecting the propeller and no damage ensued. The propeller also derived much protection from the semi-tunnel in which it turned. At full speed, the boat literally rode on this column of water in the tunnel and traveled on an even keel, regardless of how any load was located in the hull. Too, these hulls could carry weight. Their construction was sturdy and could take hard knocks; powerful motors could be installed. Supplies could be loaded aboard along with plenty of passengers without ruining the boat's performance.

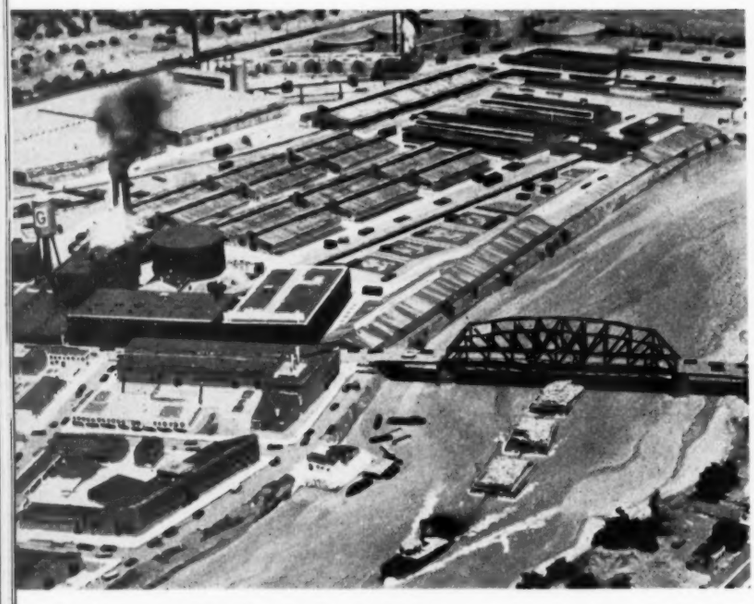
This was the kind of boat the oil men had long needed. Exploration firms bought one or two, then sent in repeat orders for more. The word spread around. After unbelievable performances in the Louisiana bayous and marshes, boats were ordered for use in the wilds of South America, in Asia, everywhere. In fact, according to one oil exploration headquarters in New Orleans which from its experience in the boating angle was called upon to act as a procurement agent for other explorers, a sizeable fleet of these boats was shipped to the Dutch East Indies, and according to reports recently received, the boats saw long service and were shipped out of the islands in a hurry so as to be perfectly sure the Japs wouldn't get them!

Notice of these unusual boats was taken by the army, navy and coast guard. The navy was interested in boats for landing parties for sailors and marines, boats that really could be beached. Trial jobs resulted in larger orders with the navy as with the oil explorers.

While the original spoonbills, first of the famous Higgins "Eureka" models, were made of Philippine mahogany, experimentation proved that arc-welded steel construction was also possible as this model did not depend upon lack of weight to give it performing ability. More and more steel construction was in order, with trained welders becoming proficient in fashioning the craft. As the building firm expanded into steel work, oil firms bought other boats of different types, tugs, cargo carriers and so on; building experience was thereby gained in fabricating larger craft. When the war burst upon Europe, Higgins Industries, Inc., had an efficient nucleus of experienced executives and workmen to expand into a real organization. Mass production of boats for war usage was a natural result. A huge order for motor torpedo boats was executed for the British government. As the war progressed and became more imminent to America, the navy demanded unheard-of numbers of landing craft. The spoonbilled exploration boat was developed into a landing boat capable of mounting machine guns and carrying fifty or more men, and capable of ploughing through any surf, bouncing off rocks and onto beaches and landing its men practically dry-shod and then racing back to the ship for more.

Architecture of Concealment—

Vital in Defense of Refineries



Intelligent camouflaging involves the altering of surrounding reference points as well as the target itself. In the above photo showing an imaginary plant the width of the river, type of bridge, and many other features help to identify the area from above.

The same scene as shown on the left after the camoufluer has applied his art. Screening of river house, wharves, bridge; narrowing of the river (through use of floating nets); disruptive painting—all combine to confuse the approaching bombardier.

TWO HOURS' FLIGHT from our West Coast, dawn is breaking over the ocean's rim. On the aircraft carrier that flies the flag of the Rising Sun, the flight commander is giving final instructions as the ship manoeuvers into the wind.

"On the west side of Greenhill, look for two Greek Theatres in the center of a large recreation park. Bomb anywhere in the recreation park, but particularly those Greek Theatres."

And that's how much good it would do to camouflage one target with another just as visible. Just one reconnaisance flight in search of the Greenhill Chemical Corporation—granted that the enemy knows its general location—would reveal the incongruous arrangement of Greek Theatres and tennis courts that disguised respectively the huge, vital storage tanks, and the more spread-out manufacturing plant, distillery, etc.

I have used an exaggerated example, perhaps, but it is indicative of some of the rationale that must lie behind every single camouflage job which has been, or now is, quietly under way in America. To call camouflage a science may be correct. But it is more than science—it is an art, with a definite technique. It may properly be called the architecture of concealment. It is decidedly a tailor made job—custom-built to the last detail. During the eight months since Pearl Harbor, a small handful of artists and engineers have been spending their days and most of their nights devising effective means of concealing West Coast defense plants from the eyes of the enemy. As a member of this group, I have seen professional interest in camouflage grow from the stage of scattered individual effort by a single designer here and there, to a group effort; thence, to a series of organized camouflaging units. It was a rapid transition—but no more rapid than the gathering hunger for knowledge displayed by industry at large toward this architecture of concealment. The information which these camoufleurs have gained constitutes neither professional nor government secrets, for their use belongs to every industry which, in wartime, wants to protect its valuable assets and products for the Nation's continued use, through the passive defense of concealment.

There is no opportunity to employ mass production methods in the design of camouflage. It is not like a ready-cut home or pre-fabricated fence that can be bought by the yard and installed according to a page of printed instructions and accomplish its mission equally well wherever or by whomever it is installed. It would be nice if the plant executive could phone his maintenance department and instruct them to order twenty thousand square feet of camouflage material and roll it over the factory like a carpet, thus removing his plant from the landscape as far as visibility is concerned. On the contrary, local conditions of the terrain—for instance, nearness to the seashore, with its change in actinic light—make it necessary for each job of camouflage to be given individual and specialized attention.

The camoufleur or designer is the man who formulates the scheme or manner in which each separate plant is to be obscured. In our opinion, he should be on the spot and familiar with the operations of the factory under transformation. He must understand the manner of living of the people in adjacent territories. He must see with his own eyes traffic problems and points of congestion, and should observe from the air the organic structure in the earth which weaves itself like a tapestry across the map. Further, the camoufleur must be familiar with the type and construction of buildings surrounding the factory. In our work, we feel we must know what kind of foliage grows in the immediate area—when it is in full leaf—when the branches are naked—when the sun and fog and rain are most likely to bring about the critical condition of exaggerated visibility. Clearly, all sections of the nation are not alike in soil, topography, and foliage. It is impractical for a designer, working in one city, to direct camouflage theory and procedure for defense plants in a variety of local scenery scattered from Seattle to Boston.

By Harper Goff

Harper Goff the author of the accompanying article has distinguished himself since America entered the war by designing and supervising camouflaging of factories on the West Coast, including one of the great aircraft plants. For the past three years, while carrying on as set designer and illustrator for Warner Bros. Pictures, Goff has studied camouflage in association with his friend, Robert Gillespie, Lieut. U. S. Army Engineer Corps. Within seventy-two hours after Pearl Harbor, Goff, Lieutenant Gillespie, Bert Teitlebaum, head of Warner Bros. Art Department, and Arthur Kooken, Warner's Chief Draftsman, had organized the famous Warner Bros. Camouflage Unit.

Perhaps among the most important weapons of concealment architecture are color and texture. Use of special paints compounded for low visibility and other factors to be later discussed, plus nets, artificial and natural foliage, earth—and a vivid imagination, combine to render effective camouflage. Contrary to prevalent opinion, it is not necessarily the camoufleur's function to hide or eliminate the factory from enemy eyes. One of his most important jobs is to confuse. It would be possible, with sufficient money and time, to hide completely many a plant, but most authorities, in computing the speed of an approaching bomber and the limited time which the bombardier has to find his target, agree that so-called total camouflage is not essential in many instances and would frequently be impractical.

Because camouflage is a three dimensional problem, it is almost universally studied by the means of a miniature. This necessity is dictated by the fact that sunlight and shadow are ever changing and a two dimensional scheme does not solve this telltale factor. Today when a camoufleur is commissioned to design a "cam job," he immediately confers with local civilian defense authorities, plant owners, adjacent property owners and the Army Command. From air photos and sketches he painstakingly builds a scale model of the area, working out his problems thereon. These are sufficiently accurate that their public display would be against the nation's best interests. However, I was recently commissioned to build a pair of hypothetical models, from which the photos appearing herewith were taken. These models were prepared for Premier Oil & Lead Works of California, developers of a spectacular infra-red, heat deflecting camouflage paint on which I rely for many effects. Together the models show the scene before, and after, a comprehensive camouflage design has been applied to a factory and its environs. The center of interest is a large American factory, which we call the Greenhill Manufacturing Company, embodying all the buildings to be found in nearly every kind of industry. This imaginary factory exists on a river. On one side of the factory are main line tracks and rolling tree-dotted hills; on the other, the edge of an average size industrial town. It has various pronounced landmarks including a bridge, dock, slips, parking lots, storage tanks and numerous other reference points. Across the river is a small town with nearby farms, and a curving highway which is normally used to transport farm produce and tourists rather than industrial trucking. All the difficult problems that beset a camoufleur have been included in this one example. It is to be hoped that very few plants would incorporate all of these trying problems.

To camouflage only the factory would not have been intelligent practice. If the enemy expects to find the target in a certain location, he will be suspicious if none is visible. He will study photographs more carefully and quickly find the exact location of the hidden plant. To hide or obscure adjacent reference points even several miles away is as necessary as to do so to the target itself. If the enemy is to be kept from rapidly penetrating our mask, we must resort to area camouflage. In this model, it will be seen that we have taken full advantage of common physical characteristics of the river above and below the actual target. Of course, in a real problem, such total camouflage can only be accomplished with the understanding and cooperation of everyone in the target area. At least 35% of the effectiveness of camouflage depends upon what is known as "camouflage discipline," or the willingness of everyone in the area under observation to abide by a set of rules. These may include such widely varied requests as the prohibition of smoking chimneys; the abandonment of certain roads; the constant maintenance of shine-reducing or glare-reducing properties on railroad tracks and high tension wires; the organization and distribution of traffic at certain hours; the parking of cars according to a preconceived plan; the frosting of certain windows to eliminate sunset and sunrise glare, and hundreds of other inconveniences that may be visited upon the people in the entire area surrounding the target.

In this model, a large portion of the factory—administration building and numerous plant buildings—were "broken up" by painted surfaces having the appearance of smaller buildings from bombing altitudes. The shape and height of smoke stacks were minimized by irregular shaped light wood and cable fins attached about halfway up the stack—painted to blend into the surrounding design. In dealing with our shadow problem, it can be seen that paint alone is not enough. Paint needs an ally—a three dimensional structural sun-reflecting and shadow casting ally. Light must be introduced into shadow areas and incidental shadow areas introduced back into light areas. Long straight persistent shadows cast by rows of buildings must be broken up by these structures. Their construction must be such that only its effect, or visual properties, are visible from the air. Methods of supporting and maintaining these shapes, nets or canopies must not be seen. No matter how clever and how real a forest may look, a photographic interpreter is on the lookout for telltale signs that will reveal man-made construction. The type of construction, of course, must be cheap, fire-proof, water-proof, and wind-proof. It must be light weight and have a certain amount of elasticity. Hard-boiled construction looks static and stiff from the air. Pliant circus tent construction, moving a little in the breeze, is more desirable. This construction must also be designed with a view toward maintenance. If our war continues longer than optimists say, it may be necessary to renew our paint from time to time. And, of course, we have the changing seasons which in some climates present a continuous maintenance problem.

The appearance of forested areas in the camouflaged model are accomplished through nets and flexible wire mesh on which is laced and draped colored tattered cloth and kindred material, known as garnish, and the whole painted according to a pattern. In an effort to make a flat surface take on protuberances and depressions, I find it helps to take advantage of the high and low visibility property of certain pigments. It is not done by contrasting values alone, but by the use of colors and shades of widely separated specular visibility. Brilliant primary colors of high visibility used next to background colors of olive drab and grays, will seem to pop or stand out giving the appearances of relief. Careful study of this phenomenon enables the camoufleur to simulate structures in relief on a perfectly smooth surface without resorting to tricks of perspective which are effective under some conditions and from certain view points but are completely in error from another. The combination of deception, removal of shapes and substitution of others, alteration of appearance of highways, bridges, and parking lots—all were accomplished in this model without hindering the normal production of the plant or flow of surrounding traffic. Of course, there are all degrees of camouflage besides

the costly total camouflage which these models demonstrate. There are numerous places where the train and highway sheds included here, and necessary to continue the forest design, would not be practical. Yet, primary camouflage with paint alone is frequently considered enough to confuse the approaching bomber until an antiaircraft barrage can come into play.

No single mechanical consideration is more important to the camoufleur than paint. For no matter how successfully our camouflage hides the plant from the bombardier's eyes, one must remember that he is equipped with highly technical photographic apparatus which is designed to penetrate paint and net camouflage. It does this by means of color filters and infra-red film, which betray man-made and man-painted imitation vegetation and other surfaces. To overcome this weakness, alert paint manufacturers in America's paint industry have been on the job. Today, we have camouflage paints that react to all known photographic and sensitometer tests precisely as does natural foliage. This one advancement in technology has been an immeasurable aid to camofleurs throughout the land. These new infra-red reflecting properties have also increased

1.

Model showing petroleum storage tanks; a four track mainline railroad; a distillery; other factory buildings, all clearly visible from the air.

2.

Here disruptive painting with low-visibility, infra-red resistant camouflage paints has altered the scene. A simple train shed effect can be accomplished with painted chicken wire stretched over framework. From bombing altitudes such painting could confuse sufficiently to frustrate the attack.

3.

In this final scene, total camouflage, representing the addition of nets, natural and artificial foliage, and plywood shapes, puts the air observer "in the woods" completely.

the durability of paint as well as to reduce the inside temperature of the object painted as much as 15 degrees when compared with the same color in ordinary paint. Perhaps I should explain a little more about what we have learned to require of camouflage paints. Frankly, its technical requirements are such as virtually to nullify the camoufleur's efforts if they are not met. The architecture of concealment is worthless if it interferes with the normal production capacity of the plant to which it is applied. This means more than merely avoiding fastening nets and fabrics where they will be tripped over—it means retaining as pleasant working conditions as possible by specifying a heat-resisting camouflage paint to replace the gleaming aluminum paint widely used to deflect heat. More than a mere notion, this point was proved decisively in the first few "cam jobs" which were constructed in America after December 7th.

It is as necessary to protect the production capacity of our plants as it is to protect our shores against invasion. There are people vitally interested in helping you solve these problems in the architectural, structural, paint, and material field of American industry. Invite them to help you.

1.

Vertical view of a hypothetical manufacturing center, showing numerous bombing targets. The altitude is considerably less than customary for enemy bombing.

2.

This is the same view after low visibility camouflage paint (disruptive camouflage) has been applied. There has been sufficient alteration to confuse bombardier from an altitude of 20,000 feet or more.

3.

Identical scene after total camouflaging, consisting of nets and fabrics, plywood shapes, camouflage paint, train sheds, and floats on the river.

FIBRE CANS FOR MOTOR OIL

Raymond S. Macmillan, president, Macmillan Petroleum Corporation, Los Angeles, California.

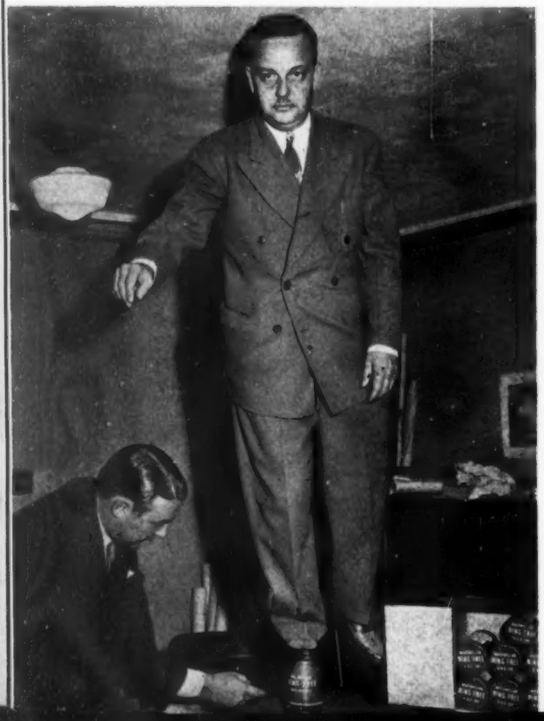
ALTHOUGH the government has decreed that after September 30 no more tin plate can be used in packaging products for civilian consumption this need not prevent oil companies from continuing the use of sealed containers for lubricating oils or other petroleum products, according to Raymond S. Macmillan, president of Macmillan Petroleum Corporation. At a press conference in New York on August 31 Mr. Macmillan announced that as a result of experiments extending over the past five years Albert A. Robbins, consulting chemist and research engineer to the Macmillan Research and Development Laboratories, had developed a fibre container that meets the most exacting tests for packaging motor oils and other hydro-carbon products.

Three-ply, spirally wound kraft paper comprises the body of the container. The adhesives used in joining the walls and the coating applied to the interior provide the distinctive feature of the container. Three compounds are employed; one to unite the layers of paper forming the walls, one to cover the interior surface and one to attach the label to the exterior of the package. All are derived from the same base by slightly varying methods of treatment and all are said to be impervious to penetration by oil. The constituents used include corn or other grains, flaxseed, tallow, animal tissues, bone and clay. The product is described as a tough and elastic synthetic plastic impervious to penetration by oil and capable of withstanding rough handling and wide ranges of temperature. The method of obtaining it is by mixing the ingredients in proper proportions and subjecting them to heat under heavy pressure in the presence of a catalyst the nature of which is not revealed.

In addition to replacing critical materials which shortly will become unavailable the advantages claimed for the fibre container are a saving in cost estimated as high as 40 percent under normal conditions, a reduction of 10 percent in shipping weight and a more convenient shape for handling. Only a one-quart size is being manufactured thus far but the possibility of producing larger sizes and of substituting it for steel drums is envisioned. The process of coating and sealing the containers will be made available to the petroleum industry, Mr. Macmillan says, the present idea being that companies desiring to adopt the package will make their own manufacturing arrangements.

With tin for the lube oil can becoming increasingly scarce, Frank J. Marron, Hollywood station operator compares it with the new light weight all-fibre can developed by Macmillan Oil Company. The all-fibre can was developed by Albert A. Robbins, research chemist for Macmillan and consists of a spirally wound container made of straw chip and waste paper; the lining is derived from grain, flaxseed, tallow, animal tissue, bones and clay.

An inner liner of plastic affords sufficient structural strength to the new all-fiber carton for motor lubricants to support the weight of W. L. Erickson of Macmillan Oil Company while O. M. Harness, salesmanager, looks on.



Macmillan's all-fibre can cut open reveals the plastic lining which makes the container strong, pliable and liquid proof.

What is the Sharples stake in the petroleum industry?

Here are the Facts

Production of Sharples centrifuges is currently running nine times the average of the prewar decade. At the present writing 89½% of these machines are to be used partly in the refining of petroleum and principally in the maintenance of its purity during use. . . . Where the use of centrifugal force is indicated, nothing can compete with its effectiveness.

THE SHARPLES CORPORATION

SHARPLES

Representatives throughout the world

★ *CENTRIFUGAL AND PROCESS ENGINEERS* ★

2337 WESTMORELAND STREET · PHILADELPHIA · PA.

LONDON PARIS

NEW YORK BOSTON PITTSBURGH CLEVELAND DETROIT

CHICAGO DALLAS SEATTLE SAN FRANCISCO LOS ANGELES

Preventative Maintenance of Oil Industry Equipment

Rubber

OF LATE the rubber manufacturing companies have gone to considerable trouble in spreading advice to users of rubber articles on how to conserve this indispensable material. It will be a long time before any new rubber, whether natural or synthetic, will become available for any but the most urgent uses. It behooves every plant manager to listen to this advice which is freely offered by responsible firms who know all about rubber and its care.

PROPER CARE OF RUBBER HOSE
PROPER CARE OF RUBBER BELTS
PROPER CARE OF MANHATTAN FIRE HOSE.

Here are three wall charts compiled by Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc. of Passaic, N. J. In each case are given plain and to-the-point directions on how to obtain the longest and most satisfactory life from these articles. There are a number of things to be done to keep them in proper condition, and a number of things *not* to be done to them. The list of don'ts is rather long, which indicates that there are many ways of damaging rubber equipment; these should be borne in mind and avoided.

RUBBER: How You Can Help Conserve V-Belts Vital to Victory—Issued by Dayton Rubber Mfg. Co., Dayton, Ohio.

If you use V-belts this concise, illustrated story on how to conserve them will interest you.

INDUSTRIAL RUBBER PRODUCTS CONSERVATION: Issued by Goodyear Tire and Rubber Co., Akron, Ohio.

This is a manual of 38 pages which explains in much detail what to do with conveyor belts, transmission belts, elevator belts, V-belt, hose, hose fittings, plioweld, and how to salvage rubber. The text is plain and concise and to make sure that no one can misunderstand what is meant there are dozens of pictures and diagrams showing how and what. Rubber equipment should last a long time in a plant where the advice contained in this manual is taken to heart.

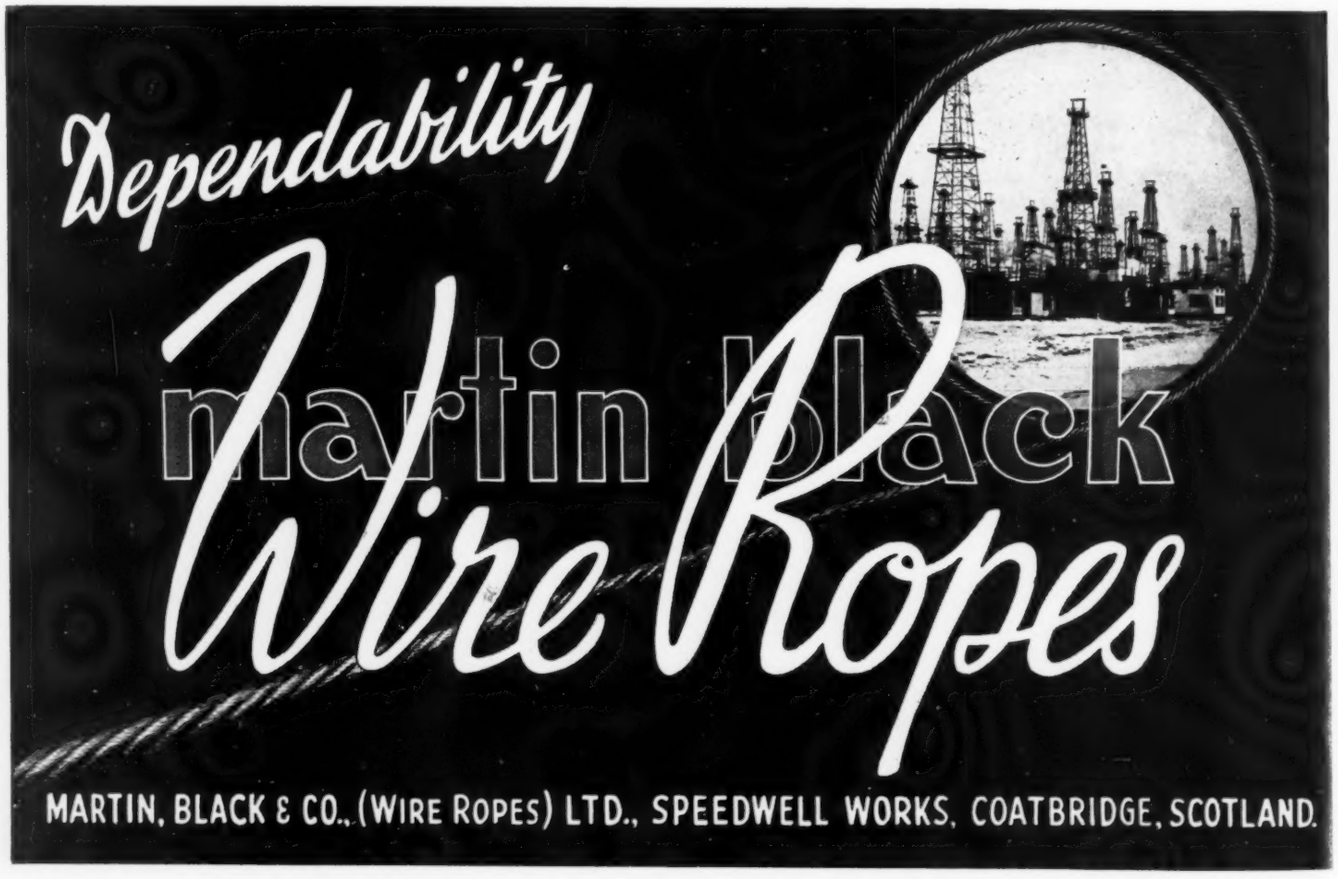
More than that, Goodyear has established a free conservation service for industrial rubber products which is offered without charge. Any plant may consult Goodyear's technical service about rubber conservation, regardless of whether the original installations were by Goodyear. The company calls this service an effort to help industry to extract every bit of life and service from every ounce of rubber.

TAYLOR ANEROID MANOMETER: Issued by Taylor Instrument Companies, Rochester, N. Y.

Mercury is one of the critical materials, and a good deal of it is needed in current types of control instruments. An instrument which releases vital mercury for the war effort, and avoids certain disadvantages in its use, is described in this publication. Incidentally, the new instrument does away with lost time in the maintenance of mercury control instruments.

SELF-LOCKING NUTS: Issued by Elastic Stop Nut Corp., Union, New Jersey.

One way to promote preventive maintenance is to have safe, tight fastenings under all operating conditions. Safe and tight fastenings means, among other things, bolts and nuts that will not be loosened by vibrations, shock, or hard usage. The oil industry has many places where shock, vibration and hard usages tends to make things come loose. This publication can be recommended as a contribution to preventive maintenance, particularly in oil field applications.



WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry — Edited by Dr. O. W. Willcox.

GEOPHYSICS

Depth of Salt in the Salt Dome Province of Southern Mississippi—C. A. Swartz, before SOCIETY ECONOMIC GEOPHYSICISTS, Denver Meeting, April, 1942.

Much of the Gulf Coast must be underlain with a vast deposit of salt which has been deeply buried under great accumulations of sediments. From this parent body of salt innumerable salt plugs have been forced upward by pressure to form the salt domes that have given rise to structural traps in which oil has accumulated, no drill has ever penetrated to the mother salt bed; how far down it lies has been a matter of speculation.

Some seismographic evidence gathered by the author suggests that the base of the salt bed is at 23,000 to 25,000 feet below the level of the present sea. This evidence has the following form: Reflection records shot and recorded directly over several domes show a number of shallow reflections from the sedimentary beds above the dome, followed by a long blank space at the end of which strong reflected events appear. It is assumed that the blank reflection-free space represents travel time in the uniform salt mass, and that the prominent reflection immediately following it is from the source bed, which calculation places at the aforementioned depths.

OPERATIONS

The Merical Perforation Cleaner—James H. Collins, in PETROLEUM WORLD, Vol. 39 (1942), No. 5, pp. 29-30.

The perforations or slits in the casing of an oil well sometimes become clogged by various substances that impede the inflow of oil from the formation and thus lower the output of the well. Various troublesome or ineffective devices have been tried to clean out these slits. The author describes a trick invented by Ford Alexander which has been successful in California. The device consists of a "rope" that carries a small amount of a high explosive which can be fired with the usual dynamite cap and blasting machine. In operation, a length of the "rope" corresponding to the perforated zone is lowered into the hole and fired from the surface; the force of the explosion blows the obstructions out of the slits.

The principle of the invention is to produce an explosion of great violence which will still exercise no destructive effect on the well. This is governed by the choice of explosive. In this case the explosive consists of small amounts of a mixture of mercury fulminate, tetryl and TNT. The characteristic of this mixture that it is a "fulminant" rather than an "explosive," it delivers an extremely hard blow within a radius of a few inches, but lacks volume to produce effects at a distance; hence there is no extensive destruction.

Since June, 1941, some 200,000 feet of this "rope," which weighs only a few ounces per foot, have been used in California wells. In one instance where a well with a perforated zone of 60 feet was producing 6-8 bbl. a day, one shot increased the yield to 89-90 bbl. In another case the yield was jumped from 30 to 130 bbl. and in still another from 1 to 15 bbl. The treatment seems to be especially effec-

Holman HARD HITTING HAMMERS

PNEUMATIC

PLANT

SPECIALISTS

Holman BROS. LTD.
CAMBORNE - - - ENGLAND

Phone: Camborne 2275
Grams: "Airdrill-Camborne"

tive in heavy crudes, which appear most prone to clog the perforations.

It is said that in many California wells not over 10 per cent of the perforations are open, which would sem to offer a considerable field to the new method.

Collecting and Examining Subsurface Samples of Petroleum—Peter Grandone and Alton B. Cook, in BUREAU OF MINES TECHNICAL PAPER 629; 68 pages.

This manual is designed for enabling petroleum engineers to solve problems that arise in the production of petroleum from natural reservoirs, such as: (1) Saturation pressure of the reservoir oil; (2) compressibility of the liquid phase at reservoir temperature; (3) total quantity of gas dissolved in different oils at different pressures and temperatures; (4) quantity of gas liberated from solution in oils upon decrease of pressure; (5) contraction of liquid resulting from liberation of gas from solution in oils or upon reduction in temperature; (6) density and specific volume of the gas-saturated liquids; and (7) pressure-volume relationships of oil-gas mixtures.

The method which the Bureau has developed for the purpose employs a special sampling instrument for obtaining samples of oil under the conditions that actually exist at the bottom of the well. The instrument, which is very fully described, comprises a pressure-tight chamber which has a valve-closing mechanism actuated by springs, and a time-controlled electromagnetic device which seals the sample in the chamber so that, when brought to the surface, the sample will be under the same pressure and have the same content of dissolved gases that it had under the original reservoir conditions. Auxiliary equipment is described, with full directions on how to release the sample and subject it to laboratory examination.

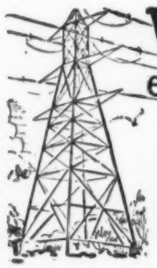
NATURAL GAS

Compressibility Factors of Several Natural Gases, and Their Applications—A. B. Stevens and Harold Vance, in OIL WEEKLY, Vol. 106 (1942), No. 1, pp. 21, 26.

If all gases were ideal gases, that is, if they implicitly obeyed Boyle's law according to the equation $PV = \text{Constant}$, the problem of designing gas handling installations would be comparatively simple. Natural gas, however, is more compressible than is predicted by Boyle's law in the lower pressure and normal temperature ranges. To take account of this erratic behavior, the equation for the ideal gas law as applied to natural gas should be amended to read $PV = KNRT$, wherein K is a deviation or compressibility factor, N is the number of mols of the gas under consideration, R is the universal gas constant, and T is the absolute temperature. The values of N, R, and T are easily obtainable, as they apply to all cases; K, however, has to be found out by experiment on the particular type of natural gas that comes into question. In practice, a natural gas containing 95 per cent of methane will be less easily compressible than one with 85 per cent of methane.

The usefulness of these compressibility factors in comparison with reliance on the ideal gas law is shown by examples. A thousand cubic feet of a natural gas containing 94.63 per cent of methane, if compressed to a pressure of 2000 lbs. per square inch gauge at 85° F., should occupy a volume of 8.65 cubic feet, but by experiment the authors found the actual volume after compression to be 6.8335 cu. ft., which makes considerable difference in engineering calculations. This is one example of the application of the compressibility factors which the authors have determined in their laboratories at Texas A. and M. College.

Another application is the estimation of gas reserves; for instance, the engineer has calculated the void spaces available for gas in the gas cap of an oil field and found this volume to be 400,000,000 cubic feet. The reservoir temperature is 152.4° F., the reservoir pressure is 2500 lbs. per square inch gauge, and the gas contains 85.00 per cent of methane, with small amounts of ethane, propane, butanes, and higher. By the ideal gas law the volume of gas in the reservoir should be 58,360,000,000 cu. ft.; applying the experimentally determined compressibility factor the real volume is 69,331,680,000 cu. ft., which is again a considerable difference. The authors give charts from which may be obtained the compressibility factors of four more or less typical natural gases. In practice, the correction is applied to the volume of gas as measured by the orifice meter, due account being taken



Wherever there is electrical equipment —

The 46-RANGE UNIVERSAL

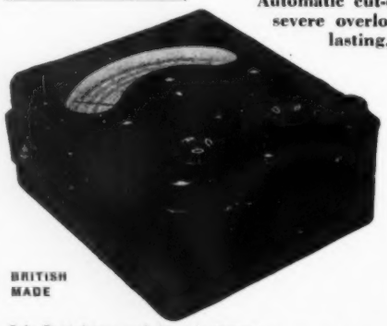
AvoMeter Model 7

Electrical Measuring Instrument

46 RANGES ONE INSTRUMENT

Current, A.C. and D.C. (0 to 10 amps.)
Voltage, A.C. and D.C. (0 to 1,000 volts.)
Resistance (up to 40 megohms.)
Capacity (0 to 20 mfds.)
Audio-frequency Power Output (0 to 4 watts.)
Decibels (—10 Db. to +15 Db.)

Because of its outstanding versatility, accuracy and simplicity the Model 7 Universal AvoMeter is the most widely used of all test meters. A compact multi-range A.C./D.C. instrument, it provides for 46 ranges of direct readings covering every essential electrical test. No external shunts or multipliers. All measurements made from two terminal points only—selection of any range by means of two simple switches. B.S. 1st Grade accuracy. Automatic cut-out protects meter against severe overload. Robustly built for lasting, reliable service.



BRITISH MADE

Some delay in delivery of Trade Orders is inevitable, but we shall continue to do our best to fulfill your requirements as promptly as possible.

• *Write for fully descriptive literature and current prices.*

Sole Proprietors and Manufacturers:—
THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.
Winder House, Douglas Street, London, S.W.1, England. *Telephone: Victoria 3404-7.*

Achievement

11-ENGINE FEN SCHEME COMPLETED

The illustration shows the largest of four Pumping Stations (4 engines, totalling 1,440 B.H.P.) now in service for the North Level Commissioners.
The scheme has a total power output of 2,510 B.H P., and is another instance of the adoption of Crossley-Premier horizontals for pumping duty. Continuous operation over long periods has been a feature of these engines for many years, due chiefly to simplicity and strength of the mechanical details.

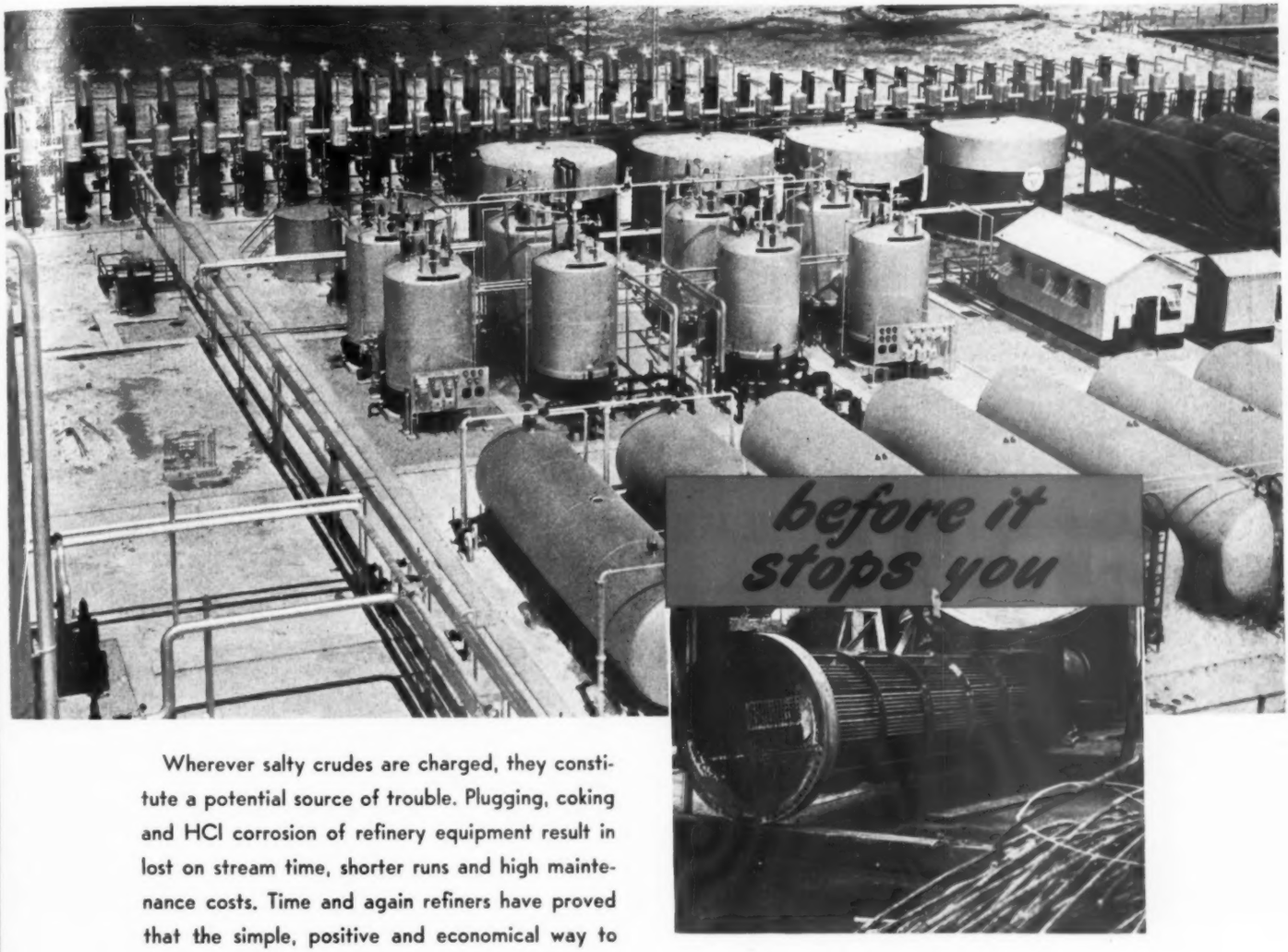
CROSSLEY-PREMIER DIESEL ENGINES

POWERS UP TO 3,000 B.H.P

CROSSLEY-PREMIER ENGINES LTD., SANDIACRE, Near NOTTINGHAM, ENGLAND

36-F P.40

STOP SALT TROUBLE



Wherever salty crudes are charged, they constitute a potential source of trouble. Plugging, coking and HCl corrosion of refinery equipment result in lost on stream time, shorter runs and high maintenance costs. Time and again refiners have proved that the simple, positive and economical way to stop salt trouble is to eliminate the cause. Petreco's highly efficient salt removal is successfully doing this for many leading refiners. Petreco engineers, familiar with the performance records of Petreco units in refineries everywhere, are available for consultation on your salt problems.

PETROLEUM RECTIFYING COMPANY
of CALIFORNIA

5121 South Wayside Drive, Houston, Texas
Edison Building, Toledo, Ohio
530 West Sixth Street, Los Angeles, California

Representatives In All Principal Oil Fields and Refining Centers

PETRECO
DESALTING DEHYDRATING

of the temperature, by multiplying this volume by the square root of one divided by the experimentally determined compressibility factor.

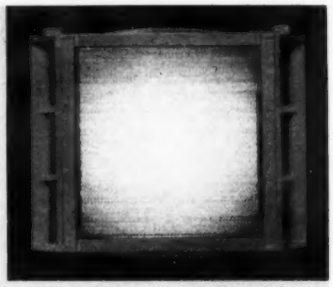
Increasing Recovery of Liquefied Petroleum Gases in Natural Gasoline Plants—J. W. Wilson, before NATURAL GASOLINE ASSOCIATION AMERICA, Tulsa Meeting, May, 1942.

The national emergency has created an insistent demand for all butane and isobutane that can be obtained from any and all sources in order to cover the stupendous requirements for synthetic rubber and 100 octane number gasoline. The natural gasoline industry will have to supply part of these essential raw materials.

The purpose of this paper is to advise natural gasoline plant operators how to increase their output of butane and isobutane, using their existing equipment (complete recovery would require the presence of precision fractionating and refrigerating equipment. Ed.). The first step will be to determine the present extraction efficiency of the plant by making low temperature distillation analyses of inlet and outlet gases, from which the overall absorber efficiency of the plant may be calculated from the following formula:- "Oil ratio vapor pressure of normal butane at the temperature of the oil leaving the absorber is multiplied by 75 and this result divided by the absolute working pressure of the absorber using the same units of pressure."

The two dominant factors in the absorption process are pressure and temperature. The formula will indicate what changes in these factors will be advisable (if practicable). By increasing pressure less oil is required or a given amount of oil will absorb more gas; a lower temperature in the absorber will have the same effect, and of course a simultaneous increase of pressure and lowering of temperature will cumulatively increase extraction efficiency. It will also help if the quality of the absorber oil is carefully looked into to make sure that it meets all the specifications that are put on absorber oils of the best type.

Above,—section of Oceco Flame Arrestor Element—actual size—and at the left, the rigid semi-steel housing, with "element" partially removed.



Oceco Flame Arrestor Element photographed against the light showing the absence of obstruction—and easy inspection.

OCECO *Straight Through* FLAME ARRESTOR PASSAGES

1. Positively prevent flame passage
2. Permit free tank venting
3. Minimize entrainment of condensates
4. Assure easy, quick inspection

• As thousands of users know, Oceco Flame Arrestors give real protection to tanks storing volatile liquids. The corrosion-resisting "bank" or "element" assembled from flat and corrugated sheets of aluminum, arranged alternately to form vertical straight through passages is an absolute flame stop,—yet assures free tank breathing with minimum pressure drop. The entire absence of screens and tortuous channels minimizes entrainment of condensation, and clogging, avoiding tank "cave-ins" and "blow-outs",—and permits easy inspection simply by looking through. Rigid gas-tight semi-steel housings of Oceco Vent Units provide maximum protection against the heat of nearby fires, not afforded when housings of lower melting point material are used.

Our recently completed Catalog No. V-50 gives complete details . . . Send for a copy today!

OCECO

Division of

THE JOHNSTON AND JENNINGS COMPANY

891 Addison Rd. **Cleveland, Ohio**

PIPE LINES

Combating Organic Fouling of Cooling-Water Circuits—F. J. Matthew, in PETROLEUM TIMES, Vol. 45 (1941), No. 1, 159, pp. 752-753.

A large problem in many if not most refineries is the fouling of water passages with slime and algae. Since the water in such passages necessarily becomes warm it offers a nearly ideal medium for the development of algae, protozoa and other microorganisms. In no great time a dense gelatinous growth accumulates on the cooling surfaces. This slime has a marked insulating effect and the cooling system loses much of its efficiency and economy.

Various methods have been devised for combatting the nuisance; treating the water with free chlorine is effective, but this expedient has some inconveniences. The author now calls attention to a simpler method which consists in placing a certain solid chemical somewhere in the cooling circuit. This chemical is sodium pentachlor phenate in briquette form which slowly dissolves in water and gives up enough free chlorine to keep the circulating water very unhealthy for algae.

The amount necessary to kill varies from 5-30 p.p.m., according to the organism; it should be noted that only in the case of certain capsulated bacteria is as much as 30 p.p.m. needed—usually about 15 p.p.m. is sufficient. This algaecidal power is uniformly maintained throughout the usual pH (hydrogen ion concentration) range found in cooling water practice. It is quite stable, the chlorine being firmly held in the molecule. It is not volatilized, oxidized or otherwise changed by aeration. It is also stable in the presence of most organic and inorganic substances, since it is relatively unreactive chemically. In addition, it is soluble in water and not corrosive to metals used in engineering construction, and in the concentration used for algae control. It does not decompose to form acid solutions. The treatment does not interfere with other treatments that may be given to the water, such as for prevention of corrosion or of scale deposition.

ASPHALT AND TAR

Rotary Viscometer for Determination of High Consistencies—R. N. Traxler, in INDUSTRIAL ENGINEERING CHEMISTRY, Analytical Edition Vol. 14 (1942), No. 4, pp. 340-344.

The design, construction, and operation of a new rotating cylinder viscometer are discussed. Its application to rheological studies is illustrated by results for asphalts over a range of 0.001 to 1000 megadynes. Novel features of the instrument comprise corrections for both top and bottom end effects and a special design whereby the viscosity is measured at a constant mean rate of shear. The apparatus is particularly adaptable for measurement of equilibrium consistency, and studies of complex flow and the elastic properties of materials having relatively high viscosities.

The authors devised their instrument on the premise that to evaluate a thixotropic material the instrument must be capable of shearing the sample at a constant rate in the same direction for an unlimited length of time. The rotating cylinder viscometer, in the various forms in which it has found extensive application, fulfills the requirement of shear in a given direction for an unlimited time. However, most rotating viscometers are designed so that the sample is tested under a constant shearing stress. This is not satisfactory for evaluating the consistencies of materials manifesting thixotropy because, as the structure within the sample is destroyed by the mechanical working, a progressive decrease in consistency occurs with a concomitant increase in rate of shear under the constant applied shearing force. Thus, with the usual type of rotating viscometer, it is difficult to compare the consistencies of different complex (non-Newtonian) liquids at the same rate of shear.

USES

Reduction of Metallic Ores by Natural Gas—Frank H. Dotterweich, in REFINER, Vol. 21 (1942), No. 5, pp. 135-138.

Reduction of metallic ores, especially iron ore, is being accomplished in localities favored by desirable proximity to the required raw materials such as coking coal, limestone, ores and favorable location relative to transportation. The Pacific Coast states have high-grade iron ores, but in the absence of coal of coking quality this operation has not become practical. Announcement of the "Clark-iron process," developed by Walter Gordon Clark of Los Angeles, comes at a time in which the expansion and separation of the metallurgical industry is highly desirable. The process consists of the reduction of metallic ores, in relatively finely divided form, by natural gas. This process has successfully passed the pilot-plant stage and is available to reduce iron, chrome, nickel, vanadium, and titanium on a commercial basis. This process promotes reduction of ores in localities heretofore ruled out due to the absence of coking coal and encourages the development of industry where large deposits of natural gas and the desired grade of ores are available.

BOOKS

Source Beds of Petroleum, by Parker D. Trask and H. Whitman Patnode, published 1942, by AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Tulsa. 566 pages; $4.50.

This volume reports an investigation sponsored jointly by the American Petroleum Institute and the Geological Survey of the United States. The circumstances that made such an investigation desirable are outlined as follows: Petroleum is a natural product which arises from the decomposition and transformation of buried organic matter. Except perhaps in sediments that later on become oil shales, the oil does not remain in the formation in which nature produced it but for one physical reason or another migrates until it is finally caught in a porous structural or stratigraphic trap, which may be a porous limestone or a sand. The object of the wildcat driller is to sink a well into the trap where the oil has finally come to rest, and he relies on the petroleum geologist to tell him (if possible) where the trap is. It may turn out that when the structure located by the geologist is drilled into, no oil is found. The question may then be asked whether the apparent absence of oil is due to lack of source beds in the vicinity or to improper selection of the site for drilling on the structure.

It thus becomes of importance to know whether adequate source beds were ever present in the vicinity. If it could be proved that oil was never generated in the area, the oil company could be advised against further drilling in that area. On the other hand if favorable source beds are known to have been present, intensive prospecting could

Today's Oil News Today

Responsible oil men depend on Ira Rinehart's Oil Reports for "Hot" daily information on drilling wells, production, pipe line, statistical and political news in the mid continent and gulf coastal regions.

Daily reports issued except holidays and Sundays in special mimeographed form. Maps of all "hot" areas given and all news of the southwest thoroughly covered and analyzed by a highly trained and specialized group of experts and staff men stationed at every important oil city.

Texas-Arkansas-Louisiana-New Mexico reports published at Fort Worth and Houston. Oklahoma-Kansas reports published at Tulsa. We respectfully solicit your inquiries at any of our publishing offices.

Ira Rinehart's
OIL REPORT
PRIVATE & CONFIDENTIAL

HOUSTON, TEXAS
504 West Bldg.
Phone: C-1385

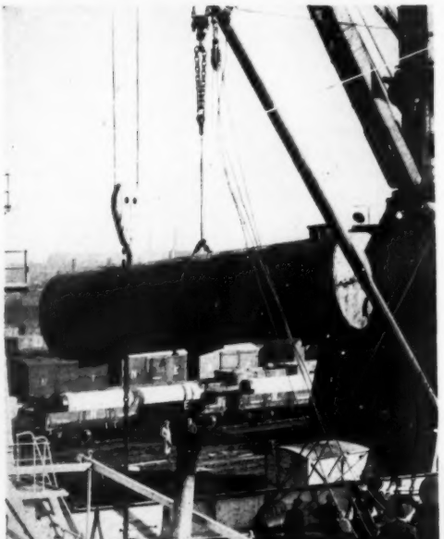
FORT WORTH, TEXAS
720-723 Fair Building
Phone: 2-7178

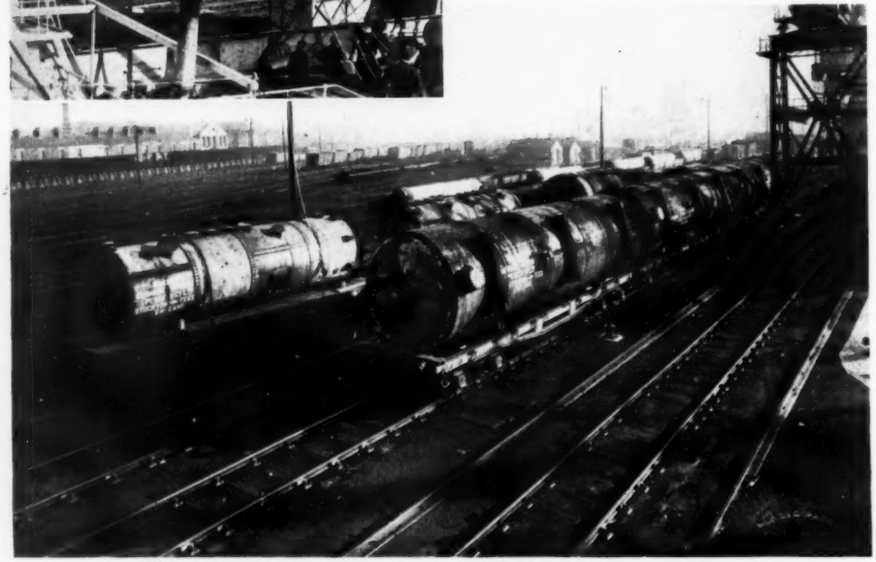
TULSA, OKLAHOMA
606 Daniel Building
Phone: 4-4138

ESTABLISHED IN 1924

MODERN INDUSTRIAL PLANT

IN
STEEL
CAST IRON
AND
COPPER
SUPPLIED
AND
ERECTED
THROUGHOUT
THE
WORLD
FOR ALL PURPOSES





Shipment of a consignment of over 600 tons from our works.

ASHMORE, BENSON, PEASE & CO. Ltd.
STOCKTON-ON-TEES ENGLAND

SULPHURIC ACID
CHEMICO CHEMICAL CONSTRUCTION CORP.
Production
Recovery
Concentration

Whether your acid requirements involve large or small quantities, consult the Chemico engineers for authoritative advice and recommendations. Chemico service includes design of plant, furnishing of equipment, training of crew, and guarantee of performance, based on 28 years of specializing on acid production and recovery.

Chemical Construction Corporation
30 Rockefeller Plaza, New York, N. Y.
Cables:—Chemiconst, New York
European Representatives, Cyanamid Products, Ltd., Berkhamsted, Herts., England

CHEMICO PLANTS are PROFITABLE INVESTMENTS

CLAYTON TANKS
FOR OIL STORAGE

IMPORTANT CONTRACTS CARRIED OUT IN-
GT. BRITAIN FALKLAND IS.
GIBRALTAR BERMUDAS
CEYLON

CLAYTON, SON & Co. LTD
HUNSLET LEEDS. ENGLAND
LONDON OFFICE 2 VICTORIA ST. S.W.1

be recommended. It thus becomes desirable to have criteria for identifying source beds. The only way to work out such criteria would be to analyze the rocks in the vicinity of known oil deposits, and from the analyses deduce signs that oil had been generated in or near them.

This the authors have done on a large scale. They procured approximately 35,000 samples from wells and outcrops in oil regions in 15 states. The distance of each sample from known oil deposits was noted, and each sample was tested for eight well defined properties. Out of these eight properties only one was sufficiently consistent to be of use in oil prospecting. This is the ratio of the nitrogen content of the rock to its reducing power on a standard solution of chromic acid. This ratio they call the nitrogen-reduction ratio; it is numerically the smaller the nearer the formation from which the rock sample was taken is to a known oil-bearing formation. The implication is that if rock samples from a dry hole have a very low nitrogen-reduction ratio, the chances are that a better-placed hole would strike oil. On the other hand, if the nitrogen-reduction ratio is high, the chances of finding oil by further drilling in the vicinity, either laterally or vertically, are remote.

Although the authors feel that they have discovered a valuable new help in oil prospecting, they are duly conservative and are careful to point out its limitations. Moreover, they present their data in great detail, so that readers and students can see exactly on what their conclusions are based. Petroleum geologists, especially those who have to do with new drilling, should acquaint themselves with the contents of this book.

GENERAL

Wildcat Drilling in 1941—Frederic H. Lahee, before AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Denver Meeting, April, 1942.

Data assembled by the author show that in 1941 the total number of wildcat wells (in the 24 states where there was any reported wildcatting) was 3,264 with a total footage of 11,615,085 feet; the corresponding figures for 1940 were 3,038 and 10,144,870. The average depth of hole, taking the whole country over, was 3,539 feet, although in the southern states the average depth was 4,372 feet. The record for 1941 is thus somewhat above that of 1940, but the increase has not been extensive enough to bring the curve of wildcat drilling up to the 1937 peak. Of the 3,264 holes made in 1941 throughout the country 503 were producers and 2,761 were dry holes, or 1 producer to 5.44 dry holes, although the ratio was somewhat better in the southern states (1 to 5.05). The percentage of successful holes drilled on technical advice was 19.5, while blind wildcatting registered only 3.7 per cent.

Commenting on the overall declining rate of discovery the author says that it cannot be due to lessened activity in wildcatting, for, except for a temporary setback in 1939, the number and average depth of wildcats has increased through the 5-year period. Nor can it be due to any lessened application of technical methods in exploration, for there has been a steady advance in the refinement and use of techniques. He believes it is due mainly to the growing difficulty of finding new geological traps for oil. The more conspicuous and easily mapped structures have long ago been located and drilled. Also, drilling has tested most of the shallower prospects on these structures. Re-

maining undiscovered reserves are largely either (1) in regions not yet explored; or (2) they are in reservoirs deeper than those reached on already exploited structures and often unconformably related to the strata that contain the known reserves; or (3) they are in reservoirs of the stratigraphic pinch-out type, which can seldom be located by surface observations.

Oils From Waste Rubber—Anon., in PETROLEUM TIMES, Vol. 46 (1942), No. 1167, p. 177.

Experiments have been carried out at the Berlin Institute of Lignite and Mineral Oil Research with a view to the recovery of petrol and heavy oils from old rubber tires which can no longer be used for rubber reclamation. Large tonnages of these are accumulating in all countries, but no successful efforts for their chemical utilization have as yet been made.

Treatment by low-temperature carbonization yielded 46 per cent (by weight) of "coke," and 35 per cent of "tar," besides smaller amounts of gas, fluid, etc., but the chemical properties of the rubber, coke and tar differ from those of comparable materials of different origin. The low-temperature carbonization coke from rubber is distinguished by low ash content and does not lend itself for use as either activated coal or fuel.

The low-temperature carbonization rubber tar yielded on distillation 16.8 per cent (by weight) of gasoline, 50.7 per cent of diesel oil, and 32.3 per cent of residual oil. The rubber gasoline was found to have good anti-knock properties, but it is difficult to refine owing to the high sulphur content of the vulcanized rubber from which it is derived. Besides, it was found to contain resinous substances.

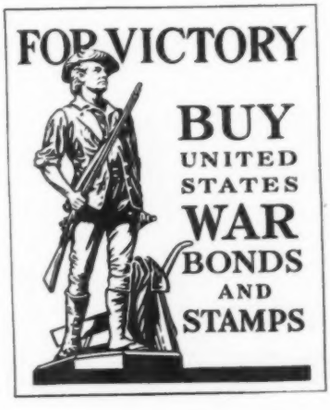
The diesel and residual oils were mixed so as to give a fuel oil of rather low viscosity. It is claimed that this material should be suitable for mixture with fuel oils from low-temperature coal tar or similar materials with a too high viscosity. As this fuel oil accounts for 83 per cent of the distillates from the carbonization tar, it is equal to 29 per cent of the total rubber waste subjected to low-temperature carbonization. For the remainder no details of possible utilization have been given by the Institute, nor is it stated whether a commercial exploitation of the process is practicable in present circumstances.

88 Miles Per Gallon—G. G. Bigger, in SHELL NEWS, Volume 10 (1942), No. 4, pp. 11-15.

In the 1942 "Marathon" by employees of Shell's Wood River (Ill.) refinery, a 1937 De Soto car was driven over an official course (14 miles); gasoline consumption over this course by this car was at the rate of one gallon to 88.3 miles. Other cars ran over the same course with gasoline consumption at rates of 83.4 and 71.6 miles per gallon; 29 cars in all averaged 57.6 miles per gallon.

The record of 88.3 miles per gallon was obtained by having all engine parts clean and in excellent condition, tires properly inflated, brakes in order, wheels properly aligned, and with automatic chokes disconnected; the cars were driven at "reasonable" speeds. Besides these ordinary, but often neglected details, the participants in the contest took some special measures, which included insulating the engine, manifold and carburetor to conserve heat. A large factor in establishing these mileages lay in the road skill of the drivers, who were allowed to take advantage of every opportunity for coasting. Speeds over the course averaged about 15 miles, seldom exceeding 20 miles per hour.

USE AQUAGEL FROM GRASS ROOTS TO COMPLETION
NO MUD CHANGE NECESSARY IN SHALLOW WELLS
SPUDDING IN: AQUAGEL controls surface water, checks caving and consolidates loose formations. Yield of about 100 barrels per ton results in low mud costs.
TROUBLESOME FORMATIONS: AQUAGEL extends interval of "straight" drilling. Lost circulation and heaving and sloughing caused by infiltration of water are reduced to a minimum.
CEMENTING: Cementing failures are reduced because of the effectiveness of the bond between casing and formation brought about by the thin AQUAGEL filter cake. This is particularly important in cases where water sands separate oil sands.
DRILLING IN: No mud change necessary when entering the producing zone. The advantageous characteristics of AQUAGEL-water mud which eliminate troubles in drilling the upper hole are equally as beneficial for "drilling in." This is important because it enables the total depth of shallow wells to be drilled before casing is set.
CLEANING UP: Thin AQUAGEL filter cakes disintegrate easily into small fragile pieces which readily swab through the liner. Their quick removal from the face of the formation opens up all of the oil sand taken. Less swabbing is necessary and higher potentials are realized.
AFTER COMPLETION: Spare sacks of AQUAGEL can be moved without loss to another location.
Trained Baroid engineers with completely equipped service cars will help solve your drilling mud problems at the well. This service is free to all operators.
PATENT LICENSES, unrestricted as to sources of supply of materials but on royalty basis, will be granted to responsible oil companies and operators to practice the inventions of any and/or all of United States patents Nos. 1,575,944; 1,575,945; 1,607,082; 1,591,637 and further improvements thereof. Applications for such licenses should be made to Los Angeles office.
BAROID SALES DIVISION
NATIONAL LEAD COMPANY
BAROID SALES OFFICES: HOUSTON • LOS ANGELES • TULSA
BAROID PRODUCTS: BAROID and COLOX • AQUAGEL • FIBROTEX • BAROCO • STABILITE • AQUAGEL-CEMENT
SMENTOX • ZEOGEL • IMPERMEX • MICATEX • TESTING EQUIPMENT • BAROID WELL LOGGING SERVICE



STORAGE TANKS

any capacity

for OIL, PETROL, ETC.

ARC WELDED

We are experts in the designing, manufacture and erection of Welded Tanks.

COMPLETE INSTALLATIONS

Send us your Enquiries

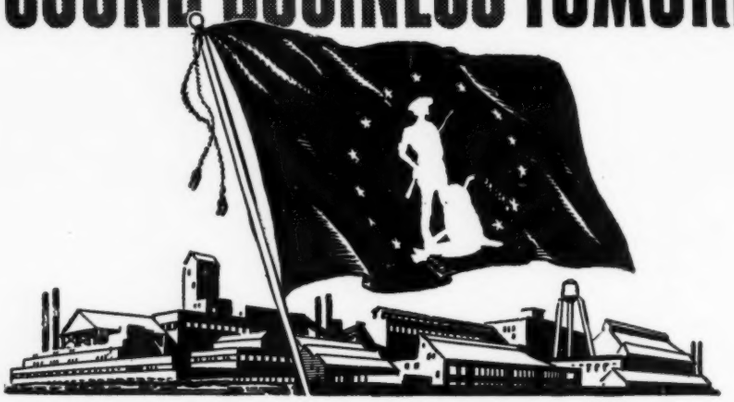
Oxley Engineering Co., Ltd.

HUNSLET LEEDS, 10 ENGLAND

Telephone LEEDS 27468/9 Telegrams: OXBROS LEEDS

LONDON OFFICE: Winchester House, Old Broad Street, E. C. 2
Telephone: LONDON WALL 3731

FOR VICTORY TODAY
AND SOUND BUSINESS TOMORROW



Get This Flag Flying Now!

This War Savings Flag which flies today over companies, large and small, all across the land means *business.* It means, first, that 10% of the company's gross pay roll is being invested in War Bonds by the workers voluntarily.

It also means that the employees of all these companies are doing their part for Victory . . . by helping to buy the guns, tanks, and planes that America and her allies *must* have to win.

It means that billions of dollars are being diverted from "bidding" for the constantly shrinking stock of goods available, thus putting a brake on inflation. And it means that billions of dollars will be held in readiness for post-war readjustment.

Think what 10% of the national income, saved in War Bonds now, month after month, can buy when the war ends!

For Victory today . . . and prosperity *tomorrow,* keep the War Bond Pay-roll Savings Plan rolling in *your* firm. Get that flag flying now! Your State War Savings Staff Administrator will gladly explain how you may do so.

If your firm has not already installed the Pay-roll Savings Plan, *now is the time to do so.* For full details, plus samples of result-getting literature and promotional helps, write or wire: War Savings Staff, Section F, Treasury Department, 709 Twelfth Street NW., Washington, D. C.

Save With

War Savings Bonds

This Space Is a Contribution to America's All-Out War Program by

WORLD PETROLEUM